This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

Proceedings of the United States National Museum

United States National Museum, Smithsonian Institution, United States. Dept. of the Interior

Digitized by Google

3 2044 106 442 528

Ber
US
4-11

HARVARD UNIVERSITY

LIBRARY

OF THE

GRAY HERBARIUM

Received 16 Sept. 1913.

2 ft.

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

SMITHSONIAN INSTITUTION

UNITED STATES NATIONAL MUSEUM

PROCEEDINGS

OF THE

UNITED STATES NATIONAL MUSEUM

VOLUME 44

WASHINGTON
GOVERNMENT PRINTING OFFICE
1913

Digitized by Google

ADVERTISEMENT.

The scientific publications of the National Museum consist of two series—Proceedings and Bulletins.

The Proceedings, the first volume of which was issued in 1878, are intended primarily as a medium for the publication of original papers based on the collections of the National Museum, setting forth newly acquired facts in biology, anthropology, and geology derived therefrom, or containing descriptions of new forms and revisions of limited groups. A volume is issued annually or oftener for distribution to libraries and scientific establishments, and, in view of the importance of the more prompt dissemination of new facts, a limited edition of each paper is printed in pamphlet form in advance. The dates at which these separate papers are published are recorded in the table of contents of the volume.

The present volume is the forty-fourth of this series.

The Bulletin, publication of which was begun in 1875, is a series of more elaborate papers, issued separately, and, like the Proceedings, based chiefly on the collections of the National Museum.

A quarto form of the Bulletin, known as the "Special Bulletin," has been adopted in a few instances in which a larger page was deemed indispensable.

Since 1902 the volumes of the series known as "Contributions from the National Herbarium," and containing papers relating to the botanical collections of the Museum, have been published as Bulletins.

RICHARD RATHBUN,
Assistant Secretary, Smithsonian Institution,
In charge of the United States National Museum.

JUNE 16, 1913.

Digitized by Google

TABLE OF CONTENTS.

Page.

ALEXANDER, CHARLES P. A revision of the South American dipterous insects of the family Ptychopteridæ.—No. 1953. February 20, 1913 [1] 331–335

New species: *Tanyderus patagonicus.*

———. A synopsis of part of the neotropical crane-flies of the subfamily Limnobinæ.—No. 1966. April 30, 1913 [1] ... 481–549

New species: *Lecteria obliterata, L. matto-grossæ, Mongoma disjuncta, M. niveitarsis, M. extensa, M. longifusa, Gonomyia (Leiponeura) puer, G. (Gonomyia) delicata, G. (G.) unicolor, Sacandaga parva, Cryptolabis tropicalis, Molophilus thaumastopodus, M. guatemalensis, Erioptera (Mesocyphona) splendida, E. (M.) knabi, E. (M.) eiseni, E. (M.) costalis, E. (M.) immaculata, E. (M.) bicinctipes, Gnophomyia magnifica, G. subhyalina, G. hirsuta, Polymera pleuralis, P. conjuncta, P. superba, P. niveitarsis, P. thoracica, P. inornata, P. grisea, Epiphragma imitans, E. pupillata, E. buscki, Limnophila epiphragmoides, L. nacrea, L. lentoides, L. guttulatissima.*
New subspecies: *Erioptera (Mesocyphona) parva*, var. *brasiliensis, E. (M.) caloptera femoranigra, E. nigrolineata*, var. *pubescens.*
New name: *Epiphragma fabricii.*

BIGELOW, HENRY B. Medusæ and Siphonophoræ collected by the U. S. Fisheries steamer "Albatross" in the northwestern Pacific, 1906.—No. 1946. March 26, 1913 [1] 1–119

New genera: *Meator, Halistaura.*
New species: *Meator rubatra, Pandea rubra, Calycopsis nematophora, Tima saghalinensis, Crossota alba, C. pedunculata.*
New variety: *Catablema vesicaria*, var. *nodulosa.*
New subfamily: Clausophyinæ.

BRUNER, LAWRENCE. Results of the Yale Peruvian expedition of 1911. Orthoptera (Acridiidæ-short-horned locusts).—No. 1949. February 11, 1913 [1] 177–187

New genera: *Cumainocloidus, Urubamba.*
New species: *Cephalocoema vittata, Meloscirtus montanus, Cumainocloidus cordilleræ, Urubamba aptera, U. inconspicua, Paradichroplus andeanus.*
New variety: *Dichroplus peruvianus auriventris.*

[1] Date of publication.

Digitized by Google

Page.

CAUDELL, A. N. Results of the Yale Peruvian expedition of 1911. Orthoptera (exclusive of Acridiidæ).—No. 1956. February 20, 1913 [1] 347–357

New species: *Chorisoneura peruana, Ischnoptera pampaconas, Blattella stylata, Blatta tincochaca, Autolyca transversata, Nannotettix paltaybamba, N. peruvianus, Antulacomera maculicornis, Anurogryllus fuscus.*

———. Notes on nearctic orthopterous insects. I. Non-saltatorial forms.—No. 1970. April 18, 1913 [1] 595–614

New species: *Manomera orthostylus.*

COCKERELL, T. D. A. Some fossil insects from Florissant, Colorado.—No. 1955. April 30, 1913 [1] 341–346

New genus: *Eobruneria.*

New species: *Eobruneria tessellata, Libellulapis wilmattæ, Janus disperditus.*

CUSHMAN, JOSEPH A. New Textulariidæ and other arenaceous foraminifera from the Philippine Islands and contiguous waters.—No. 1973. April 30, 1913 [1] 633–638

New species: *Textularia vertebralis, T. immensa, T. excavata, T. semialata, Bolivina sculpturata, Clavulina rotundata, C. primæva, Gaudryina attenuata, G. robusta, Virgulina cornuta, Thurammina papyracea, Reophax agglutinatus, Ammochilostoma rotundata.*

DYAR, HARRISON G. Descriptions of new lepidoptera chiefly from Mexico.—No. 1951. February 11, 1913 [1] 279–324

New genera: *Epimolis, Hypenopsis. Calomathetes, Edia, Paranatula, Ballovia.*

New species: *Phyciodes natalces, Thespieus cacajo, T. zaovinia, Amblyscirtes tutolia, Staphylus holaphegges, Argopteron dividuum, Megathymus rethon, Hylesia iola, H. coinopus, Sisphynx modena, Eurota descintes, Ptychoglene stenodora, Euchaetias cressida, E. rhadia, E. epagoga, Calidota calosoma, Ammalo tenerosa, Amastus edaphus, Epimolis zatrephica, Pericopis zeladon, Lygranthoecia amblys, Miselia transvitta, M. caloscotina, Hyssia pseudochroma, Cirphis striguscula, Hadena lithaphania, Eriopyga loliopopa, E. cracerdota, E. vesquesa, E. oache, E. ultimella, E. dolia, E. enages, Momaphana sylvia, M. annadora, Baileya restitans, Bagisara oula, B. demura, B. xan, Perigea sutrix, P. pyromphalus, Hydroecia arnymai, Nocloa periodita, Chalcopasta chalcocraspedon, Tarachidia heonyx, Eustrotia pulmona, Diastema panteles, Eutelia amatrix, Celiptera surrufula, Zale rhigodora, Campometra distilla, Matigramma psegmapteryx, Prothymia cataplexis, Pleonectyptera ignilinea, Pangrapta alopopis, P. herbitecta, Glympis phoenicimon, Dasylophia rufitincta, Calomathetes halmaphylla, Psilocron aphrethesa, Farigia malomen, Oenotrus melanodora, O. bipennis, Hydriomene potosiata, H. grettaria, Catoclothis gymnopomparia, Cambogia agroica, C. operbula, C. saria, Tephroclystia glaucotincta, T. molliaria, Meleaba urania, M. antithetes, Tachyphyle aganapla,*

[1] Date of publication.

Digitized by Google

DYAR, HARRISON G.—Continued. Page.

Anisodes poliotaria, Cænocharis ouden, Sciagraphia deceptrix, Semiothisa phanerophleps, Physostegania melanorrhœa, Deilinia graciosa, Digonodes maidiena, Selenia ismalida, S. ricochetta, Hygrochroma hyalopuncta, Tephrinopsis coniaria, Diastictis lamitaria, Anisodes mesoturbata, Phigalia cryptapheles, Cœnocalpe sistenata, Apicia entychon, Stenacidalia unidentifera, Tephrosia supplanaria, Mesoscia dumilla, M. eutecta, Gingla raconica, Lacosoma medalla, L. julietta, Meskea horror, M. subapicula, Dysodia monava, Phlyctænodes cupreicostalis, Nomophila irregulalis, Pyrausta minimistricta, P. xanthocrypta, Crocidolomia ochritacta, Polygrammodes bæuscalis, Edia microstagma, Doratoperas systrapegus, Tioga bunniotis, Paranatula zographica, Melitara parabates, Euzophera griselda, E. immorella, Ballovia cistipennis, Givira gabriel, G. felicoma, Arbela naida.

New subspecies: *Thespieus dalmani guerreronis.*

———. Descriptions of new species of Saturnian moths in the collection of the United States National Museum.—No. 1947. February 20, 1913 [1] 121–134

New species: *Hylesia gyrex, H. mymex, H. tapabex, H. ochrifex, H. index, H. pollex, H. valvex, H. murex, H. ascodex, H. leilex, H. murmur, H. oratex, H. cotex, H. rex, H. orbifex, H. remex, H. livex, H. liturex, H. molpex, H. mortifex, H lolamex, H. schausi, H. pauper, H. mystica, H. athlia, H. cedomnibus, H. vindex, H. solvex, H. cressida, H. euphemia.*

GEROULD, JOHN HIRAM. The sipunculids of the eastern coast of North America.—No. 1959. April 12, 1913 [1] 373–437

New genus: *Siphonosoma.*

New species: *Phascolosoma cinereum, P. cinctum, Physcosoma capitatum, Aspidosiphon parvulus, A. speciosus.*

New varieties: *Phascolosoma margaritaceum* var. *meridionalis, P. eremita* var. *scabra, Phascolion strombi* var. *fusca, P. s.* var. *alba, P. s.* var. *hyalina, P. s.* var. *gracilis, P. s.* var. *canadensis, P. s.* var. *lævis, Sipunculus priapuloides* var. *americana.*

GIDLEY, JAMES W. A recently mounted zeuglodon skeleton in the United States National Museum.—No. 1975. April 30, 1913 [1] 649–654

GILBERT, CHARLES H. Descriptions of two new fishes of the genus Triglops from the Atlantic coast of North America.—No. 1963. April 30, 1913 [1] 465–468

New species: *Triglops ommatistius.*

New subspecies: *Triglops ommatistius terrænovæ.*

HAY, OLIVER P. Notes on some fossil horses, with descriptions of four new species.—No. 1969. April 30, 1913 [1] 569–594

New species: *Equus leidyi, E. littoralis, E. niobrarensis, E. laurentius.*

[1] Date of publication.

Digitized by Google

Page

HOLLISTER, N. A synopsis of the American minks.—No. 1965. April 18, 1913 [1] 471–480

New subspecies: *Mustela vison letifera.*

JORDAN, DAVID STARR. Description of Anguilla manabei, a new eel from Japan.—No. 1957. April 3, 1913 [1] 359–360

New species: *Anguilla manabei.*

MALLOCH, J. R. Descriptions of new species of American flies of the family Borboridæ.—No. 1958. February 20, 1913 [1] 361–372

New species: *Aptilotus borealis, Sphærocera annulicornis, Borborus neglectus, B. brevisetus, B. lacteipennis, B. articus, Limosina lugubrina, L. rotundipennis, L. niveipennis, L. parva.*

———. Notes on some American diptera of the genus Fannia, with descriptions of new species.—No. 1972. April 30, 1913 [1] 621–631

New species: *Fannia conspicua, F. benjamini, F. howardi, F. morrisoni, F. æthiops.*

———. Two new species of diptera in the United States National Museum collection.—No. 1962. February 20, 1913 [1] 461–463

New species: *Fannia tibialis, Limosina trochanteratus.*

MCMURRICH, J. PLAYFAIR. Description of a new species of actinian of the genus Edwardsiella from southern California.—No. 1967. April 18, 1913 [1] 551–553

New species: *Edwardsiella californica.*

MERRILL, GEORGE P. A newly found meteorite from near Cullison, Pratt County, Kansas.—No. 1952. April 12, 1913 [1] 325–330

RADCLIFFE, LEWIS. Descriptions of seven new genera and thirty-one new species of fishes of the families Brotulidæ and Carapidæ from the Philippine Islands and the Dutch East Indies.—No. 1948. April 3, 1913 [1] 135–176

New genera: *Homostolus, Enchelybrotula, Mastigopterus, Hypopleuron, Luciobrotula, Xenobythites, Pyramodon.*

New species: *Neobythites longipes, N. (watasea) unimaculatus, N. (w.) purus, N. (w.) fasciatus, Dicrolene longimana, D. tristis, Homostolus acer, Monomitopus pallidus, M. longiceps, M. microlepis, Monomeropus garmani, Barathrodemus nasutus, Bassogigas æquatoris, Enchelybrotula paucidens, Eretmichthys remifer, Bassozetus robustus, B. elongatus, Mastigopterus imperator, M. prætor, Glypiophidium lucidum, G. oceanium, Lamprogrammus macropterus, Hypopleuron caninum, Diplacanthopoma (Sarcocara) brunnea, Grammonus robustus, Catætyx platycephalus, Luciobrotula bartschi, Bythites lepidogenys, Xenobythites armiger, Hephthocara crassiceps, Pyramodon ventralis.*

[1] Date of publication.

Digitized by Google

Page.

RATHBUN, MARY J. Descriptions of new species of crabs of the family Ocypodidæ.—No. 1971. April 30, 1913 [1]..... 615–620

New species: *Uca samboangana, U. mearnsi, U. novæguineæ, Macrophthalmus crinitus.*

RICHARDSON, HARRIET. Terrestrial isopods collected in Costa Rica by Mr. Picado, with the description of a new genus and species.—No. 1954. February 20, 1913 [1]..... 337–340

New genus: *Pentoniscus.*

New species: *Pentoniscus pruinosus.*

ROHWER, S. A. Results of the Yale Peruvian expedition of 1911.—Hymenoptera, superfamilies Vespoidea and Sphecoidea.—No. 1960. February 20, 1913 [1]..... 439–454

New species: *Cryptocheilus peruvianus, Psammochares (Psammochares) dichromorpha, Arachnophroctonus xanthopterus, Ceropales basirufus, Chrysys (Tetrachrysis) rugosa, Hypodynerus nigricornis, Odynerus (Stenodynerus) hirsutulus, Pseudelaphroptera (?) maura, Campsomeris (Campsomeris) similaris, Sphaerophthalma salaverensis, S. peruvianus, Callosphex erythrogastra, Isodontia bipunctata, Sphex (Sphex) peruvianus.*

SNYDER, JOHN OTTERBEIN. Notes on Ranzania makua Jenkins and other species of fishes of rare occurrence on the California coast.—No. 1961. April 12, 1913 [1]..... 455–460

VIERECK, H. L. Descriptions of six new genera and twelve new species of Ichneumon-flies—No. 1974. April 18, 1913 [1]. 639–648

New genera: *Amyosoma, Arichelonus, Diachasmimorpha, Shirakia, Eripternimorpha, Zaparaphylax.*

New species: *Asobara orientalis, Amyosoma chilonis, Diachasmimorpha comperei, Habrobracon mali, Microbracon hispæ, Apanteles (Protapanteles) formosæ, A. (P.) narangæ, Shirakia schoenobii, A. (Stenopleura) nonagriæ, A. (S.) simplicis, Eripternimorpha schoenobii, Zaparaphylax perinæ.*

———. Descriptions of ten new genera and twenty-three new species of Ichneumon-flies.—No. 1968. April 18, 1913 [1]. 555–568

New genera: *Cœlinidea, Ericœlinius, Atanycolimorpha, Coeloidimorpha, Hysterobolus, Christolimorpha, Diapetimorpha, Ethæmorpha, Mesostenimorpha, Orthocryptus.*

New subgenera: *Ærophilopsis, Myrmicomorpha.*

New species: *Bassus (Ærophilopsis) erythrogaster, Macrocentrus (Amicroplus) plesius, Apanteles (Apanteles) laspeyresiæ, A. (A.) phycodis, A. (A.) plusiæ, Atanycolimorpha winnemanæ, Chelonus (Chelonella) bussyi, Crassomicrodus fenestratus, Euagathis cryptophlebiæ, Hysterobolus mallochi, Meteorus laphygmæ, Perilitus eleodis, Apanteles (Protapanteles) empretiæ, A. (P.) mayaguezensis, Opius (Utetes) anastrephæ, Eiphosoma (Brachixiphosoma) insularis, Christolimorpha plesius, Enicosphilus heliothidis, Itoplectis evetriæ, Mesochorus plusiæphilus, Pezomachus (Myrmicomorpha) perniciosa, Neotheronia winnemanæ, Phygadeuon (Plesignathus) epochræ.*

[1] Date of publication.

Digitized by Google

Page.

VIERECK, H. L. Results of the Yale Peruvian expedition of 1911. Hymenoptera-Ichneumonoidea.—No. 1964. February 20, 1913 [1] 469–470

New species: *Anisitsia tincochacæ, Cylloceria tincochacæ, Trachysphyrus cleonis.*

WILSON, CHARLES BRANCH. Crustacean parasites of West Indian fishes and land crabs, with descriptions of new genera and species.—No. 1950. April 3, 1913 [1] 189–277

New genera: *Dentigryps, Sagum, Cancrincola.*

New species: *Ergasilus longipalpus, E. myctarothes, Bomolochus nothrus, B. attenuatus, Artacolax palleucus, Pseudoeucanthus uniseriatus, Tæniacanthus flagellans, Caligus atromaculatus, C. afurcatus, C. enormis, C. suffuscus, Dentigryps curtus, Anuretes parvulus, Paralebion curticaudis, Lernanthropus frondeus, L. obscurus, L. spiculatus, Sagum flagellatum, Nemesis versicolor, Hatschekia albirubra, H. oblonga, H. uncata, H. insolita, H. linearis, H. iridescens, Lernæolophus recurvus, L. striatus, Thysanote longimana, Clavella inversa, Brachiella concava, Cancrincola jamaicensis, Cypridina parasitica.*

[1] Date of publication.

Digitized by Google

LIST OF ILLUSTRATIONS.

PLATES.

		Facing page.
1.	Anthomedusæ	120
2.	Anthomedusæ	120
3.	Anthomedusæ and Trachomedusæ	120
4.	Trachomedusæ and Scyphomedusæ	120
5.	Scyphomedusæ and Siphonophoræ	120
6.	Siphonophoræ	120
7.	1. *Neobythites longipes;* 2. *N.* (*Watasea*) *unimaculatus;* 3. *N.* (*W.*) *purus;* 4. *N.* (*W.*) *fasciatus*	176
8.	1. *Dicrolene longimana;* 2. *D. tristis;* 3. *Homostolus acer*	176
9.	1. *Monomitopus pallidus;* 2. *M. longiceps;* 3. *M. microlepis*	176
10.	1. *Monomeropus garmani;* 2. *Barathrodemus nasutus;* *Bassogigas æquatoris*	176
11.	1. *Enchelylbrotula paucidens;* 2. *Eretmichthys remifer;* 3. *Bassozetus robustus;* 4. *B. elongatus*	176
12.	1. *Mastigopterus imperator;* 2. *M. prætor;* 3. *Glyptophidium lucidum;* 4. *G. oceanium*	176
13.	1. *Lamprogrammus macropterus;* 2. *Hypopleuron caninum;* 3. *Diplacanthopoma* (*Sarcocara*) *brunnea;* 4. *Grammonus robustus*	176
14.	Abdominal vertebræ of *Hypopleuron caninum;* dorsal, ventral, and lateral views	176
15.	Abdominal vertebræ of *Merluccius productus;* ventral and lateral views	176
16.	1. *Catætyx platycephalus;* 2. *Luciobrotula bartschi;* 3. *Bythites lepidogenys;* 4. *Xenobythites armiger*	176
17.	1. *Hephthocara crassiceps;* 2. *H. crassiceps,* dorsal view; 3. *Pyramodon ventralis*	176
18.	Crustacean parasites of West Indian fishes	278
19.	Crustacean parasites of West Indian fishes	278
20.	Crustacean parasites of West Indian fishes	278
21.	Crustacean parasites of West Indian fishes	278
22.	Crustacean parasites of West Indian fishes	278
23.	Crustacean parasites of West Indian fishes	278
24.	Crustacean parasites of West Indian fishes	278
25.	Crustacean parasites of West Indian fishes	278
26.	Crustacean parasites of West Indian fishes	278
27.	Crustacean parasites of West Indian fishes	278
28.	Crustacean parasites of West Indian fishes	278
29.	Crustacean parasites of West Indian fishes	278
30.	Crustacean parasites of West Indian fishes	278
31.	Crustacean parasites of West Indian fishes	278
32.	Crustacean parasites of West Indian fishes	278
33.	Crustacean parasites of West Indian fishes	278

Digitized by Google

	Facing page.
34. Crustacean parasites of West Indian fishes	278
35. Crustacean parasites of West Indian fishes	278
36. Crustacean parasites of West Indian fishes	278
37. Crustacean parasites of West Indian fishes	278
38. Crustacean parasites of West Indian fishes	278
39. Crustacean parasites of West Indian fishes	278
40. Crustacean parasites of West Indian fishes	278
41. Crustacean parasites of West Indian fishes	278
42. Crustacean parasites of West Indian fishes	278
43. Crustacean parasites of West Indian fishes	278
44. Crustacean parasites of West Indian fishes	278
45. Crustacean parasites of West Indian fishes	278
46. Crustacean parasites of West Indian fishes	278
47. Crustacean parasites of West Indian fishes	278
48. Crustacean parasites of West Indian fishes	278
49. Crustacean parasites of West Indian fishes	278
50. Crustacean parasites of West Indian fishes	278
51. Crustacean parasites of West Indian fishes	278
52. Crustacean parasites of West Indian fishes	278
53. Crustacean parasites of West Indian fishes	278
54. The Cullison meteorite, Pratt County, Kansas	330
55. The Cullison meteorite, Pratt County, Kansas	330
56. Fig. 1. *Eobruneria tessellata;* Fig. 2. *E. tessellata;* Fig. 3. *Chloripps wilmattæ*	346
57. A new eel from Japan	359
58. Sipunculids of eastern coast of North America	438
59. Sipunculids of eastern coast of North America	438
60. Sipunculids of eastern coast of North America	438
61. Sipunculids of eastern coast of North America	438
62. Sipunculids of eastern coast of North America	438
63. *Ranzania makua*	460
64. *Triglops ommatistius*	465
65. Venation of neotropical crane-flies	550
66. Venation of neotropical crane-flies	550
67. Venation of neotropical crane-flies	550
68. Venation of neotropical crane-flies	550
69. *Equus fraternus* and *Equus niobrarensis*	594
70. *Equus niobrarensis*	594
71. *Equus niobrarensis* and *Equus excelsus?*	594
72. *Equus laurentius*	594
73. *Equus laurentius*	594
74. New crabs of family Ocypodidæ	620
75. New crabs of family Ocypodidæ	620
76. New crabs of family Ocypodidæ	620
77. Details of legs of species of *Fannia*	632
78. New arenaceous foraminifera from the Philippines	638
79. New arenaceous foraminifera from the Philippines	638
80. New arenaceous foraminifera from the Philippines	638
81. Skeleton of American zeuglodon	649
82. Skull and cervical vertebræ of American zeuglodon	654

Digitized by Google

TEXT FIGURES.

Page.

Vogtia spinosa..... 68

Diphyes truncata, anterior nectophore, × 5..... 74

Lateral aspect of the head of *Tanyderus patagonicus*. *a*, antenna; *b*, clypeus; *c*, maxillary palpus; *d*, labrum; *e*, maxilla; *f*, hypopharynx (?); *g*, hypopharynx (?); *h*, labium..... 332

Dorsal aspect of the head of *Tanyderus patagonicus*. *a*, antenna; *b*, clypeus; *c*, maxillary palpus; *d*, labrum; *e*, maxilla..... 333

Wing of *Tanyderus patagonicus*. Sc_1, subcosta 1; R_1, radius 1; R_5, radius 5; M_1, media 1; Cu_1, cubitus 1; *1st A*, anal..... 334

Pentoniscus pruinosus..... 338

Pentoniscus pruinosus. Second antennæ..... 338

Pentoniscus pruinosus. Maxilliped..... 338

Pentoniscus pruinosus. Inner lamella of second maxilla..... 338

Pentoniscus pruinosus. Mandible..... 338

Venation of *Osmylidia requieta*..... 342

Pygidial plate of *Libellulapis wilmattæ*..... 345

Second submarginal cell of *Libellulapis wilmattæ*..... 345

Map showing distribution of Atlantic Sipunculids..... 377

Dissection showing internal structure of *Phascolosoma eremita*. *an*, anus; *gn*, cerebral ganglion; *go*, reproductive organs; *nph*, nephridium; *tb. P*, Polian tubule..... 387

Dissection of *Phascolosoma verrillii*. *an*, anus; *go*, reproductive organs; *m. rtr*, retractor muscle; *neph*, nephridium; *oc*, pigmented eye; *tb. Pol*, Polian tubule..... 390

Posterior extremity of *Phascolosoma sabellariæ* showing papillæ..... 393

Dissection of *Phascolosoma sabellariæ*. × 13½. *an*, anus; *go*, reproductive organ; *nph*, nephridium..... 393

Dissection of *Phascolosoma improvisum* from off Niantic Bay, Connecticut, in 5 fathoms. Intestinal coil not shown. × 13½. *an*, anus; *rtr*, retractor muscle; *neph*, nephridium; *n. v*, ventral nerve cord; *oe*, esophagus..... 396

Hooks from introvert of *Phascolosoma cinereum*..... 397

Dissection of *Phascolosoma cinereum*. × 5½. *an*, anus; *go*, reproductive organs; *m. rtr*, retractor; *neph*, nephridium; *tb. Pol*, Polian tubule..... 397

Dissection of *Phascolosoma cinctum*. × 13½. *an*, anus; *m. col*, collar muscle; *m. rtr*, retractor muscle; *nph*, nephridium; *n. v*, ventral nerve cord; *oe*, esophagus..... 399

After Moltchanoff. Transverse section of the atrophied left nephridium of *Phascolion*. *c*, body cavity; *cu*, cuticula; *ep*, epidermis; *m*, muscular layer; *p*, peritoneum..... 402

Phascolion strombi..... 405

Dissection of *Phascolion strombi*. × 6½. *an*, anus; *dvt*, diverticulum; *go*, reproductive organ; *m. rtr. d*, dorsal retractor muscle; *neph'st*, nephrostome; *n. v*, ventral nerve cord; *tb. Pol*, Polion tubule..... 407

Dissection of *Phascolion strombi var. lævis*. × 6. *an*, anus; *m*, suspensory muscle of intestine; *m. rtr. d*, dorsal retractor muscle; *m. rtr. v*, ventral retractor muscle; *neph*, nephridium; *n. v*, ventral nerve cord..... 414

Dendrostoma alutaceum. × 8½. *an*, anus..... 417

Dissection of *Dendrostoma alutaceum*. × 10½. *an*, anus; *neph*, nephridium; *tb. Pol*, Polian tubule..... 418

Dissection of *Physcosoma capitatum*. × 4½. *go*, reproductive organ; *m. rtr. d*, dorsal retractor muscle; *m. sp*, spindle muscle; *neph*, nephridium; *oe*, esophagus..... 423

Dissection of *Aspidosiphon parvulus*. × 17½. *an*, anus; *m. rtr*, retractor muscle. 425

Digitized by Google

Page.
Hooks from introvert of *Aspidosiphon speciosus*. × 290 427
Apices of mandibles in *Isodontia*. A. *cinera* (cotype); B, *bipunctata* Rohwer (type); C, *macrocephala* Fox (type) 453
Transverse section of a protocnemic mesentery of *Edwardsiella californica*. *mp*, muscle pennon; *nc*, nematocyst capsule; *pm*, parietal muscle 552
Figs. 1–3. 1, *Equus fraternus*. × 1, Right upper premolar; 2, Left upper premolar; 3, Right upper premolar 570
Figs. 4–10. 4, 6, 10, *Equus fraternus*. × 1. 4, Right upper molar; 6, Left second and third premolars; 10, Right upper premolar? 5, 7, 8, 9, *Equus leidyi*. × 1; 5, Right upper premolar; 7, Right upper molar; 8, Right upper molar; 9, Right upper premolar? 573
Figs. 11–15. 11, *Equus leidyi*. × 1. Right upper premolar; 12–15, *Equus fraternus*. × 1; 12, Right upper premolar? 13, Lower right molar or premolar; 14, Lower right molar or premolar; 15, Lower left last molar 575
Figs. 16–18. 16, *Equus leidyi*. × 1. Lower left molar or premolar. 17–18, *Equus littoralis*. × 1. 17, Upper left molar. 18, Upper left molar 575
Figs. 19–21. 19, *Equus niobrarensis*. × ½. Upper jaw, left side; 20, Left lower jaw; 21, Left lower jaw 579
Figs. 22–24. 22, *Equus niobrarensis*. × ⅔. Right upper milk molars; 23, Left lower milk molars; 24, *Equus excelsus*. × ⅔. Left lower milk molars 583
Figs. 25–27. 25, *Equus laurentius*. Left upper premolars and molars. × ⅔; 26, Left lower premolars and molars. × ⅔; 27, Left side of palate. × ⅔ 587
Fig. 28. *Equus excelsus*. Last premolar and three molars of right side of upper jaw. × ⅔ 593
Tarsus of *Forficula* showing the second segment prolonged beneath the third .. 596
Basal portion of antenna of *Labia*, showing relative structure of the segments .. 596
Head of *Labia* from above, showing length of cheeks behind the eyes 597
Basal portion of antenna of *Prolabia*, showing relative structure of the segments .. 597
Head of *Vostox* from above, showing the length of the cheeks behind the eyes .. 597
Metasternum of *Labidura*, showing the posterior width as compared with that of the hind coxa 599
Metasternum of *Psalis*, showing the posterior width as compared with that of the hind coxa 599
Claws of *Eurycotis*, showing the arolia between them. Pronotal disk of *Phyllodromica*, showing coloration. Wing of *Ischnoptera*, showing venation. v, incomplete branches of the ulnar vein. Fore femora of *Blatella*, showing ventral armature. Fore femora of *Supella*, showing ventral armature. Antennæ of *Pseudomops*, showing basal swelling 600
Cerci of *Periplaneta brunnea*, female 602
Cerci of *Periplaneta americana*, female 602
Pronotal disk of *Pseudomops cincta*, showing coloration 603
Pronotum of *Stagmomantis*, showing shape. Pronotum of *Mantoida*, showing shape. Head of *Litaneutria*, showing shape of eyes. Extended anterior coxa of *Litaneutria*, showing the rounded swelling of the distal end of the inner dorsal margin. Extended anterior coxa of *Oligonyx*, showing the more prominent and abrupt swelling of the distal end of the inner dorsal margin. Antenna of *Brunnea*, showing the basal swelling. Pronotum of *Gonatista*, showing shape. Facial shield of *Stagmomantis*, showing width as compared with the height. Facial shield of *Mantis*, showing width as compared with the height. Head of *Yersinia*, showing shape of eyes 607
The tip of abdomen of *Manomera orthostylus*, showing straight cerci 612
Fore limb of American zeuglodon 651
Pelvic bone of American zeuglodon 652
Femur of American zeuglodon 652

Digitized by Google

MEDUSAE AND SIPHONOPHORAE COLLECTED BY THE U. S. FISHERIES STEAMER "ALBATROSS" IN THE NORTHWESTERN PACIFIC, 1906.

By HENRY B. BIGELOW,

Of the Museum of Comparative Zoölogy, Cambridge, Massachusetts.

INTRODUCTION.

The medusae and siphonophorae described in the following pages were collected by the U. S. Fisheries steamer *Albatross* chiefly in the northwestern Pacific, Bering Sea, the Sea of Okhotsk, and the Sea of Japan during the summer of 1906. The itinerary of the cruise will be found in the Report of the Commissioner of Fisheries for 1906, but for the convenience of the reader the localities of the stations at which medusae were taken are tabulated below.

The material as a whole is in excellent condition, and I am indebted to Dr. H. B. Torrey for the use of his field notes.

The collection comprises 58 species of medusae and 22 of siphonophorae, of which only 5 species and 1 variety of medusae are new. But the paucity of the new species is no index to the value of the collection, because two of them are interesting additions to the mesoplankton, while additional data on most of its members are very welcome, and the opportunity to compare them with their nearest allies in the Atlantic has afforded much information of zoogeographic interest.

There are no new siphonophores; but the collection contains a series of the genus *Clausophyes* previously known only from a fragment (Lens and Van Riemsdijk) and from one record which has long been regarded as problematical. The genus proves to be of great anatomic interest.

The collection also shows that the species earlier described by me (1911*b*) as "*Muggiaea kochii* Will" is the *Diphyes truncata* of Sars—a discovery of geographic interest.

PROCEEDINGS U. S. NATIONAL MUSEUM, VOL. 44—No. 1946.

69077°—Proc.N.M.vol.44—13——1

Digitized by Google

Synonymies are omitted here as a rule, references for earlier literature being given to Dr. A. G. Mayer's Monograph of the Medusae, where complete lists will be found. Similar synonymies for the siphonophores will be found in my report on the eastern Pacific collection (1911*b*).

LOCATION OF STATIONS.

(For complete list see Report of the U. S. Commissioner of Fisheries, 1906.)

4757–4762, line San Francisco to Unalaska Island.
4763–4780, Bering Sea.
4781–4783, western Aleutian Islands.
4784–4793, line from western Aleutians to Kamchatka by way of Komandorski and Bering Island.
4794–4797, off the southeast coast of Kamchatka.
4798–4800, Sea of Okhotsk.
4801–4806, east of Kurile Islands.
4807–4810, Hakodate Strait (Tsugaru Strait).
4811–4882, Sea of Japan.
4883–4936, Eastern Sea.
4937–4945, Kagoshima Gulf.
4946–4960, off the east coast of Kiushiu Island, Japan.
4961–4980, south coast of Nipon, line Kobe to Yokohama.
4981–4996, Sea of Japan.
4997–5004, Gulf of Tartary.
5005–5013, Aniva Bay, Sakhalin Island.
5014–5030, Sea of Okhotsk.
5031–5033, Yezo Strait.
5034–5045, off the southeast coast of Hokkaido.
5046–5052, east coast of Hondo.
5053–5077, Suruga Gulf.
5078–5084, east coast of Hondo.
5085–5095, Sagami Bay.

Class HYDROMEDUSÆ.

Order ANTHOMEDUSÆ.

Family SARSIIDÆ Forbes emended.

Family CODONIDAE Haeckel.

The name Codonidae is commonly employed for this family, but it must be abandoned, because *Codonium* is a synonym of *Sarsia*.

Digitized by Google

Genus SARSIA Lesson.

This genus is represented in the collection by two species, *S. eximia* Allman and *S. japponica* Maas, belonging to what Hartlaub (1907) has named the "*eximia*" group, in which the manubrium is short and is clothed with genital products from close to its base to near the lip, and one, *S. princeps*, classed by him in the "*tubulosa*" group, in which the manubrium is long, and the gonad leaves the distal portion bare. The following species, *brachygaster* Grönberg, *barentsi* Linko, *prolifera* Forbes, *radiata* von Lendenfeld, and *angulata* Mayer, are all so closely allied to *eximia* that it is questionable whether any of them are actually distinct. Thus I can find nothing in Grönberg's (1897) figure to separate *brachygaster* from *eximia*. The only difference is that in the latter the ocelli, at first black, change to carmine with growth, while in *brachygaster* they retain their black color, and I doubt whether so slight a difference is a basis for specific separation. *Sarsia barentsi* is insufficiently described; but although Mayer (1910, p. 53) believes that it is probably a young stage of *S. tubulosa*, it has a short manubrium and might equally belong to *eximia*. *S. prolifera*, in which medusa buds are formed at the bases of the tentacles, is a puzzling form, which may be the young, or a budding phase, of some other *Sarsia*, as already suggested by Browne (1896). Like *eximia*, it has a short manubrium and well-developed ocelli. *S. radiata* von Lendenfeld (1884), from Australia, likewise resembles *eximia* in the structure of its manubrium, but unfortunately it is doubtful whether or not ocelli are present. The hydroid is certainly very closely allied to *S. eximia*, with which the hydranths agree in the arrangement of tentacles and medusa buds, the only differences of importance being that the hydranths arise directly from a creeping hydrorhiza. *S. angulata* Mayer may be a variety of *eximia;* its hydroid is not known. *S. resplendens* Bigelow, from the west coast of Mexico, was described as a new species because of its short tentacles, each with a few large nematocyst swellings; and, as it was studied alive, these characters can be assumed to be normal. It is likewise characterized by a very brilliant coloration. Mayer (1910) suggests that it is really *eximia;* and it is possible that it may prove to be a variety of that species. But until it is better known, and especially till its hydroid is described, it may be retained provisionally.

S. flammea and *S. japonica* lack ocelli, a character separating them from *eximia*, which they otherwise resemble in general appearance. They are closely allied to each other; but Maas (1909, p. 6), who has examined specimens of both, believes that they can be separated by the fact that in *flammea* the sexual products are arranged in a network ("Gitterwerke") over the walls of the manubrium, while in *japonica* they are irregularly massed here and there, though leaving

Digitized by Google

no part of the manubrium definitely free except its two extremities. It is doubtful whether larger series would show that this slight difference is of much importance; but as no specimens of *flammea* have been available for study, the name *japonica* is retained here.

SARSIA EXIMIA (Allman).

Coryne eximia ALLMAN, 1859, p. 141.

Dutch Harbor, May 25, surface; 5 specimens, 4–10 mm. high; in excellent condition.

Petropaulski, June 19, surface; 1 specimen, 8 mm. high; manubrium torn off.

These specimens agree very well with the various figures of *eximia*. Hartlaub (1907) has given so full an account that no description is called for here further than to point out the more important specific characters. Chief among these is the structure of the manubrium, correlated with the presence of ocelli. In all the *Albatross* examples the manubrium is entirely contained within the bell cavity; and in view of the fact that the specimens are expanded as a whole, as is shown by the condition of the tentacles, it appears that the manubrium was short in life. The smallest individual is a female, with large eggs; the others are males; in all of them the gonads occupy the whole of the manubrium, except the lip, and a very short region at the base, so that, as Hartlaub (1907) has pointed out, there is no such distinction into genital and nutritive zones as there is in *S. tubulosa*. There is no trace of an apical canal or chamber in any of the specimens.

Color.—The ocelli are now pale reddish-brown; the manubrium pale orange. Otherwise the specimens are colorless. No color notes were made from life, so that it is quite possible that the bases of the tentacles were pigmented before preservation.

Sarsia eximia has been recorded from numerous localities on the coasts of Great Britain; from the coasts of Normandy and Brittany, Iceland, and Norway; and its hydroid is already recorded from Juneau, Alaska, by Nutting (1901) and from California by Torrey (1902). If the records of *S. brachygaster* are added, as I believe should be done, then Spitzbergen and West Greenland ought to be included; and if *barentsi* be included, the distribution of the species is extended nearly to Nova Zembla.

SARSIA JAPONICA Maas.

Sarsia japonica MAAS, 1909, p. 6, pl. 1, fig. 1.

Station 4783; about 35 specimens, the largest about 8 mm. high. The specimens were so inextricably tangled with one another and with copepods that only about 10 were separable from the mass. All are much contracted, and most of them more or less damaged.

The only important respect in which they differ from Maas's figure is that the manubria fill the bell cavities almost entirely; but this is

Digitized by Google

evidently the result of the contraction of the bell as a whole. The short manubria, irregular arrangement of the sexual products over its wall and absence of apical canal and ocelli are all easily distinguished.

Color.—In formalin, manubrium and tentacle bases are pale brownish. The original records of *japonica* were from Todohokke and Hokkaido, Japan.

SARSIA PRINCEPS (Haeckel).

Codonium princeps HAECKEL, 1879, p. 13, pl. 1, figs. 1, 2.

(For synonymy, see Mayer, 1910, p. 60.)

Station 3604, southern Bering Sea, August, 1895; surface; 1 specimen, about 30 mm. high.

The single example is flattened, and its manubrium so strongly contracted, that it is a mere knob; but the specimen is readily identified by the long "still-canal" and by the irregular margins of the radial canals though the latter are somewhat less pronounced than in a specimen from Newfoundland (1909, p. 303), as well as by its large size.

For a list of occurrences of this species, which include Newfoundland, Greenland, Davis Strait, Spitzbergen, the White Sea, and Barents Sea, see Hartlaub (1907, p. 49).

Genus HYBOCODON L. Agassiz.

The medusae of this genus may be almost indistinguishable although budded off from hydroids which are perfectly distinct; for example, the medusae of *H. christinae* Hartlaub closely resemble those of *H. prolifer* Agassiz, but the hydroids of these two species can not be confused, because in the former the medusa buds are borne singly, in the latter on stolons. The following North Atlantic species are listed by Hartlaub (1907), who has made the most thorough study of the genus: *pulcher* Saemundsson, *prolifer* L. Agassiz, *christinae* Hartlaub, *gravidum* Linko, *islandicum* Greene, and *amphipleurus* Haeckel; but as Mayer (1910) has noted, it is probable that *gravidum* and *islandicum* are synonyms of *prolifer* (of neither of them is the hydroid known); and *amphipleurus* is known from only a single specimen (medusa).

H. prolifer is very abundant off the coasts of New England; and medusae recorded under that name have been taken by hundreds in northern European waters, but the *prolifer* hydroid has not been found on the eastern side of the Atlantic.

Three other Hybocodons have been described, *H. unicus* Browne from the Falkland Islands (medusa only); *H. chilensis* Hartlaub from the Chilean coast (hydroid only), and *H. occidentalis* Fewkes from the coast of California (medusa only). *Chilensis* is allied to the

Digitized by Google

pulcher-christinae group; *unicus* is insufficiently known; it may belong to *chilensis*, as suggested by Browne (1902) and Mayer; *occidentalis* is indistinguishable from *prolifer* so far as the medusa is concerned.

The Hybocodons of the fisheries steamer *Albatross* collection can be identified only provisionally, until the hydroid is known. But as the medusae agree perfectly well with *prolifer* they are referred to that species.

HYBOCODON PROLIFER L. Agassiz.

Hybocodon prolifer L. Agassiz, 1862, p. 243, pl. 23*a*, figs. 10, 11; pl. 25.

(For synonymy, see Mayer, 1910, p. 39.)

Dutch Harbor, surface, May 25; about 50 excellent specimens, 3–5 mm. high.

Most of the specimens have three large tentacles, with one or two medusa buds; but some have only one tentacle, some two, and several have four. The medusa buds vary in number from one (in specimens with three or four tentacles) to three or four; and they are in every stage of development from mere knobs to medusae which are themselves in the act of budding. The stages agree so well with the description by L. Agassiz (1862) that no account is needed here; his figures might almost have been taken from the present series. Some specimens have no buds, and among such the tentacle number is usually three or four. Besides budding off medusae, several of the specimens have actinula-larvae in various stages of development, attached to the manubrium, just as they have been described by Hargitt and Perkins (Mayer, 1910, p. 41). And a given individual may or may not show both types of development.

Since Hartlaub (1907) believed that a short manubrium was distinctive of *H. christinae*, it is interesting that in the *Albatross* series this organ varies from being tubular and hanging to the opening of the bell, to very short, almost globular, although the bell as a whole may show no signs of contraction. Evidently, then, this character is useless in preserved material. In the smaller specimens there are no gonads, consequently the manubrium is nearly transparent. But in the larger ones the sexual products are developed. There seems to be no connection between budding and the formation of gonads.

The radial canals are all of equal breadth, and the exumbral nettle ribs are well marked. Over most of their length they are linear, but near the margin they widen suddenly.

Color.—Manubrium and tentacular bulbs are pale yellow; the apex of the manubrium orange.

Digitized by Google

Family CYTAEIDAE L. Agassiz, 1862.

Genus TURRITOPSIS McCrady, 1856.

The most recent communication on this genus is by Hartlaub (1911), who gives a discussion of the three members of the genus from northern waters, *polycirrha* Keferstein, *nutricula* McCrady, and *pacifica* Maas. The first two are very closely allied to each other, so much so, in fact, that Mayer (1910) has united them. Hartlaub, arguing to the contrary, points out that in the European form the radial canals are broader, the entodermal "Zellpolster" lower, than they are figured by Brooks for the American species; that the radial canals are not dilated within the "Zellpolster," that the latter is not four-cornered, and finally that the eggs develop into planulae within the bell cavity, something which has never been observed in the American form. But Mayer's (1910) figure of an adult from Newport has broad canals, and these are not enlarged in the "Zellpolster." I have myself examined specimens from Bermuda, the Tortugas, and Newport, and in all of them the radial canals are quite as broad as in Busk's figure of the European form; and in no case do the canals expand within the "Zellpolster" to form distinct chambers with an ascending branch such as Brooks (1886) observed, though, to be sure, they are more or less dilated. Thus it appears that the supposed differences between *polycirrha* and *nutricula* are so unstable as to be worthless for specific diagnosis, and as Mayer has studied many *nutricula* in life, I believe that we can safely follow him and Maas (1909) in uniting the two. *Pacifica* described by Maas (1909) as var. *pacifica* of *nutricula*, is distinguished from the latter by large size; by having numerous tentacles arranged in several rows, and especially by the peculiarity that the ocelli lie on the abaxial instead of the axial faces of the tentacular bulbs; and these differences have seemed sufficient both to Mayer and to Hartlaub to show that *pacifica* is a distinct species.

The present collection adds to our knowledge by affording two perfectly typical specimens of *nutricula* from southern Japan; that is, from the same general region as *pacifica*. It was of course so interesting to find two species of *Turritopsis* in Japanese waters that I paid especial attention to the position of the ocelli, finding that there is an axial ocellus on each tentacular bulb exactly as in *nutricula*. But though this character sharply distinguishes the latter from *pacifica*, number and arrangement of tentacles do not, for large specimens of *nutricula* have 70–85 or more, *pacifica* about 120–150. In the *Albatross* specimens they are apparently in two rows, but in reality only in one, the appearance being due to differences in size of tentacles of different ages, and to crowding and contraction of the

Digitized by Google

margin. And were they in several rows—that is, of the "pacifica" type—this might easily be explained as the result of progressive development. So far, then, as size and tentacles are concerned, *pacifica* might be an advanced stage of *nutricula*, but the position of the ocelli can not be reconciled with this. When I first examined the present specimens the ocelli, showing clearly through the tentacular bulbs, seemed to lie on the abaxial surfaces of the latter, and it was only when the tentacles were examined in side view that the true position of the ocelli became evident. This, together with the fact that Maas (1909) has given only an abaxial view of the tentacles, suggests the possibility that the conditions in *pacifica* might be explained in the same way. But reexamination of the specimens alone can settle it. The *Albatross* specimens are recorded as *nutricula*, as I can find nothing to separate them from that species.

TURRITOPSIS NUTRICULA McCrady.

Oceania (*Turritopsis*) *nutricula* McCrady, 1856, p. 1, pl. 4, figs. 1–10.
Oceania polycirrha Keferstein, 1862, p. 26, pl. 2, figs. 11–13.

(For complete synonymy, see Mayer, 1910, p. 143.)

Station 4943, 2 specimens, both about 4 mm. high. One is in excellent condition, the other slightly contracted.

The better specimen has about 84 large, and 5 or 6 very small tentacles; their apparent location in two rows has been touched upon. One feature not previously emphasized for *nutricula*, although it is evident in specimens from Newport, is that each tentacle has a distinct terminal dilation. The "Zellpolster" is of the quadrate type figured by Brooks (1886), and the radial canals within it are dilated but slightly. The ova (both specimens are female) cover the interradial surfaces of the manubrium, leaving the perradii bare, but no planulae are to be seen.

Nutricula has been described so often and so fully, that no further discussion is needed here. For excellent accounts and figures, see Brooks (1883), Brooks and Rittenhouse (1867), Mayer (1910), and Hartlaub (1911).

Family BOUGAINVILLEIDÆ[1] Gegenbaur, 1856.

Genus BOUGAINVILLEA Lesson, 1843.

The collection contains one large specimen of *Bougainvillea* which I can not distinguish from *B. superciliaris*, and its identity seems assured because I have been able to compare it with excellent specimens of that species from Labrador. The diagnostic features of *superciliaris* are its large size, the presence of a short gelatinous

[1] The use of the name Margellidae (Hartlaub, 1911) is untenable because *Margelis* is a synonym of *Bougainvillea*.

Digitized by Google

peduncle, long manubrium, the fact that the gelatinous substance, thick aborally, grows thinner toward the margin; the large number of tentacles; purely interradial gonads; development of the planulae attached to the walls of the manubrium; and dense pigmentation; all of which are shown by our specimen. It would be interesting to know the true relationship between *B. superciliaris* and the other *Bougainvillea* from the northwestern Pacific, *B. bougainvillei* Brandt. Mayer (1910) unites them; but Hartlaub (1911) believes that they are distinct, the latter, according to him, being more nearly related to *B. britannica*. Without access to specimens of the *bougainvillei* type, it is impossible to settle the question; but I may point out that *bougainvillei* resembles *superciliaris* in the presence of a short peduncle; that its manubrium is no shorter than I have often seen it in *superciliaris* of the same size; and that so far as general form is concerned it agrees equally well with either. Hartlaub (1911) mentions as a point of resemblance to *britannica* that the ocelli in *bougainvillei* lie on the free tentacles at their bases; but the same is true of *superciliaris*, as is clearly shown in L. Agassiz's figures (1849).

The one peculiar feature of *bougainvillei* is the presence of "sehr feinen Börstchen" on the exumbrella (Brandt, 1838, p. 393). But these spines or hairs suggest the spines of radiolarians, with which medusae are often clothed. On the whole, then, I am inclined to believe that *bougainvillei* is identical with *superciliaris*. It has been recorded by Murbach and Shearer (1903), but the identity of their specimen (not figured) is uncertain. *B. mertensi* A. Agassiz is probably a synonym of *bougainvillei*, but the original specimens of *mertensi* in the collection of the Museum of Comparative Zoölogy are distorted past hope of recognition.

BOUGAINVILLEA SUPERCILIARIS (Gould) L. Agassiz.

Hippocrene superciliaris GOULD, 1841, p. 348.—L. AGASSIZ, 1849, p. 250, pls. 1–3.

(For further synonymy, see Mayer, 1910, p. 162, and Hartlaub, 1911, p. 171.)

Attu Island, June 11; 1 specimen, 12 mm. high by 10 mm. in diameter. The example was obviously much larger in life, and it appears to be the largest representative of the species yet recorded. *B. superciliaris* has been so well described and figured by L. Agassiz (1849), Mayer (1910), and Hartlaub (1911) that no account is called for, further than to point out that our specimen shows the specific characters in a typical way. The peduncle is short and broad, and, corresponding with the large size, the interradial sides of the manubrium are covered with planulae, but none are attached along four narrow perradial lines. The manubrium itself is large, and hangs to about the mid height of the bell. The numbers of marginal tentacles to the bundle are 16, 18, 15, 15, 18 being the greatest number yet recorded. The branching of the oral tentacles is more complex

Digitized by Google

than in the smaller specimens usually described, for each tentacle forks seven or eight times.

Color.—Ocelli are dark brown, almost black; the manubrium pale reddish brown.

Genus RATHKEA Brandt, 1837 (Hartlaub).

It seems that at last the generic name for Bougainvilleidae, with eight groups of marginal tentacles and with the labial tentacles represented by nematocyst swellings at the corners of the lip, is settled. The stumbling block has long been *Rathkea blumenbachii* (Rathke) Brandt from the Black Sea, a form so poorly figured that it was impossible to determine the type of oral appendages; but Hartlaub (1911) has recently studied series from the Black Sea which prove indistinguishable from the common *Lizzia octopunctata* of the North Atlantic, and likewise specimens of that species from the Mediterranean (Trieste, Cette). There is, then, no further question that *blumenbachii* and *octopunctata* are identical, and *Lizzia* must give way to *Rathkea.*

The common Mediterranean species *fascicularis* thus loses the generic name which Maas (1905) and I formerly applied to it, and Browne (1910) has revived *Köllikeria* for it and similar species. Mayer (1910) uses *Rathkea* in a broad sense to include all Bougainvilleidae with eight groups of marginal tentacles. But I agree with Maas and with Hartlaub that the structure of the labial appendages is sufficiently important to afford a generic character of phylogenetic value, and it warrants at least two and probably three genera, *Rathkea* with simple nematocyst knobs, *Lizzia* with unbranched labial tentacles and *Köllikeria* with branched labial tentacles. The species included in *Rathkea* by Mayer are *blumenbachii* Rathke, *formosissima* Browne, *octopunctata* Sars, *fasciculata* Péron and Lesueur, *octonemalis* Maas, *elegans* Mayer, and *blondina* Forbes. According to the above definition, these species should be distributed as follows: *blumenbachii* (=*octopunctata*) to *Rathkea; fasciculata, octonemalis,* and *elegans* to *Köllikeria; blondina* to *Lizzia;* and *formosissima* also probably to *Lizzia.*

Hartlaub (1911) makes a different division, referring to *Bougainvillea* species with branched oral tentacles, and smooth, not folded, gonads and gastric walls, irrespective of the number of bundles of marginal tentacles; that is, *octonemalis* and *elegans.* But though Bougainvilleas do vary more or less in number of bundles, still the octoradial condition of *Köllikeria* is precise; it does not intergrade in any true sense with the quadriradiality of *Bougainvillea.*

Mayer (1910, p. 179) recognizes a variety of *blumenbachii, grata,* for specimens with a long peduncle; but I doubt whether the difference

Digitized by Google

in this respect is anything more than an individual variation, or perhaps partly consequent on contraction.

The *Albatross* collection contains a series of the genus which differs from *blumenbachii* in having more tentacles (five instead of three) in the interradial groups, and the case is an interesting one, because perfectly typical *blumenbachii*, with the usual number of tentacles, is common in Japan. There is, then, no question of a Pacific as opposed to an Atlantic species. The difference is merely the point to which development proceeds; the north Atlantic form at first has one tentacle in each interradial group; then a pair flanking it appear, and then in its Bering Sea relative the interradial groups simply progress one step further, just as do the radial groups. And as it appears that in some specimens from Bering Sea three is the final number, just as it is in the Atlantic species, there seems to be no justification for separating the series specifically from *blumenbachii*, though it may finally be shown that they represent a distinct local variety.

RATHKEA BLUMENBACHII (Rathke).

Oceania blumenbachii RATHKE, 1835, p. 321.

(For synonymy, see Mayer, 1910, pp. 177, 179, and Hartlaub, 1911, p. 229.)

Dutch Harbor, surface, May 25; about 40 specimens, 2–4 mm. in diameter; in excellent condition.

I have been able to compare this series with about 200 examples from Newfoundland (1909*c*., p. 306).

It is not at all surprising that *R. blumenbachii* should occur in Bering Sea, since it has already been found along the Arctic coasts of Europe as far east as Nova Zembla, and likewise in Japan.

The species has often been described, and excellent diagnoses are to be found in Mayer's (1910) and Hartlaub's (1911) papers, while the latter author has given a complete list of the localities where it has been taken.

The series contains both budding and sexual phases, besides a considerable number of specimens with both medusa buds and gonads. The largest are about 4 by 4 mm.—that is, about the same as my Newfoundland series—and the photograph of the oral appendages of the latter (1909, pl. 31, fig. 5) might equally well have been taken from one of the Bering Sea specimens. The largest individuals have seven or eight nematocyst organs in each cluster, as described by A. Agassiz (1865) and Browne (1896). According to the degree of contraction, the nematocyst knobs may be sessile, with no trace of stalk, or the lip may be extended in narrow prolongations, with the knobs at their tips, so that the latter are apparently stalked; but there is a very sharp distinction between such organs, which are merely projections of the edge of the lip, and the labial tentacles of *Cytaeis*, *Liezia*, or *Köllikeria*.

Digitized by Google

The marginal tentacles are especially interesting, because they show the only difference between the Bering Sea and the Atlantic series. About half of the specimens have five tentacles in each interradial cluster, while the others have three. There are large specimens in each class; but the series, as a whole, suggests that most examples, at any rate, attain the large number sooner or later.

In the Atlantic form, on the other hand, the final number of tentacles in each interradial cluster is three, and no specimens have ever been recorded in which this number was surpassed. Japanese examples, likewise, have only three. Each of the radial groups has five tentacles. *Rathkea* has never been observed with more than five in each. One medusa bud, almost ready for liberation, the only one found at so late a stage, has five tentacles in each radial, three in each interradial, group. In the medusa buds of the Atlantic race there are usually three tentacles in each radial and only one in each interradial group when liberated. All the specimens are of the "short peduncle" type; indeed, I have never seen one of the "*grata*" type (Mayer, 1910).

Color.—In formalin manubrium tentacle bulbs are pale yellow.

Family PANDEIDAE Haeckel, 1879 (sens. em.).

Family TIARIDAE[1] Haeckel.

MEATOR, new genus.

This new genus is proposed for an interesting new Pandeid in which the gonads consist, in the adult, of eight smooth adradial masses, discontinuous in the perradii, and in which perradial and subradial tentacles are of different sizes, though structurally all alike, characters which separate it from all other members of the family.

Type.—*Meator rubatra*, new species.

MEATOR RUBATRA, new species.

Plate 1, figs. 1–3.

Type.—Cat. No. 31051, U.S.N.M.

Station 4800, 300–0 fathoms; 2 specimens, respectively 14 mm. high by 18 mm. in diameter (type) and 13 mm. high by 13 mm. in diameter.

Station 5019, 192–0 fathoms; 1 specimen, 17 mm. high.

Station 5028, 241–0 fathoms; 1 specimen, 17 mm. high.

Station 5030, 1,800–0 fathoms; 1 specimen, 17 mm. high.

Station 5030, 300–0 fathoms; 7 specimens; the smallest specimen is 10 mm. high by 11 mm. in diameter, the largest 17 mm. high by 18 mm. in diameter.

All are in excellent condition.

Meator rubatra is so striking in its general appearance that it can not be mistaken for any other known medusa. The gelatinous sub-

[1] Untenable, because *Tiara* is preoccupied for a mollusk.

Digitized by Google

stance is extremely thick and tough, the bell almost spherical, but in all of our specimens slightly broader than high. The bell cavity is subcylindrical, one-half to one-third higher than broad, the subumbrella densely pigmented, with the jelly very transparent; the specimen looks like a vitreous ball with its center occupied by an opaque plug (pl. 1, fig. 1). The entire animal, at least after preservation, is so tough and resistant that it will bear handling even when removed from its fluid.

Manubrium.—The manubrium is short, reaching hardly to the mid-level of the bell cavity; the mouth is surrounded by four separate lips, with slightly fimbriated margins (pl. 1, fig. 3). In the large specimens the manubrium is attached to the subumbrella along each radius, as in other Pandeids, only here to an extreme degree, the lines of attachment extending downward as far as the sexual products are developed.

Gonads.—In a specimen 17 mm. high the gonads consist of eight adradial masses, oval in outline, broadest at their lower ends. The sexual tissue is, of course, discontinuous in the perradii, where there is a broad band, reaching to the base of the manubrium, along which no sexual products are present (pl. 1, fig. 3). The specimen in question is a female, with large ova. The precise outlines of the sexual masses are easily followed, because their whiteness contrasts very strongly with the dense, almost opaque endodermic pigmentation of all other parts of the walls of the manubrium. In the smallest specimen the manubrium is much contracted, and consequently the gonads folded and crumpled, and in this case the adradial gonads of each pair are close together near the bases, though still distinctly separate in the interradius.

The question whether the pairs of adradial gonads are the arms of organs originally horseshoe-shaped and secondarily separated by the growth of the manubrium remains unanswered, but the probability is that they are. In a large male the gonads agree very well with those of the female described above.

Canal system.—The margins of the canals, both radial and circular, are smooth, but in most of the specimens there is a slight dilation of the radial canals marking the level of the lower end of the perradial attachment of manubrium to subumbrella. In one example the margins of the canals are jagged at this point.

Tentacles.—The arrangement of tentacles is characteristic, there being four large perradials and a considerable number of much smaller interradials (pl. 1, fig. 2). As in *Heterotiara* and *Calycopsis* the basal ends of the radials lie in furrows of the exumbrella; and the tentacles turn outward a short distance above the margin. The interradials, however, spring directly from the margin, not touching the exumbrella. None have terminal dilations of any kind, nor are

Digitized by Google

there any distinct basal bulbs. The number of interradials increases irregularly with growth. In the smallest specimen, 10 by 11 mm., there are 6, 7, 9, and 6 interradials in the four quadrants; in a large one, 14 by 18 mm., there are 10, 10, 9, 9; and in a still larger one, 17 by 18 mm., 10, 9, 9, 10. Ten was the largest number counted in any quadrant.

The interradial tentacles are especially interesting because cross sections of them show that the stouter ones have a large lumen, whereas in smaller ones, either younger or more contracted, the lumen is obscured, so that they are apparently solid, though there is no definite core of chordate cells, such as is to be seen in *Protiara formosa* (Mayer, 1910, pl. 13, fig. 2).

Color.—The density of the pigment has been noted above. The entire subumbrella, and those parts of the manubrium which lack sexual products, are of a very deep claret red, so nearly opaque as to look black when held against the light, over which the radial canals show as pale bands. The tentacles and velum are of a very pale brownish-red, and the coloration, as well as the data of capture, shows that the species belongs to the mesoplankton.

Genus PANDEA Lesson, 1843.

Mayer (1910) admits five species to this genus: *conica* Lesson, *violacea* Agassiz and Mayer, *saltatoria* (Sars) Lesson, *minima* Lendenfeld, and *maasi* Mayer (= *Tiara*, sp., Maas, 1904*b*, p. 13, pl. 2, fig. 11). But *saltatoria* is probably an *Aglantha*, *maasi* a *Sarsia* (*S. flammea*), while *minima* was founded on a young stage. Vanhöffen (1911) has united *conica* and *violacea* on the supposition that the latter is the young of the former. But Mayer (1910) has studied large series of *violacea*, both from the Tortugas and from the Mediterranean, finding that the structure of the gonads separates them at all stages.

The collection contains a large species from the intermediate depths, referable to *Pandea*, and resembling *conica* in the structure of the gonads, but readily distinguished from the latter by size, dark red color, and other characters noted below.

PANDEA RUBRA, new species.

Plate 2, figs. 1–7.

I. ADULT.

Type—Cat. No. 31052, U.S.N.M.

Station 4758, 300–0 fathoms; 1 specimen.

Station 4760, 300–0 fathoms; 1 specimen and fragments of two others.

Station 4797, 300–0 fathoms; 1 specimen. Type.

Station 4800, 221–0 fathoms; 2 specimens, 1 very fragmentary.

Digitized by Google

The proportions of the better-preserved examples are as follows:

Station.	Height, mm.	Diameter, mm.	Interradial tentacles per quadrant.
4800	35	37	4, 2, 2, 2
4758	40	38	3, 3, 4, (?)
4797	47	38	4, 3, 3, 4
4760	[1] 75	(?)	5, 4, (?) (?)

[1] Approximate.

No one of the examples is perfect, but several of them are well enough preserved in parts to allow a general account.

The bell is about as high as, or slightly higher than broad, dome-shaped, the gelatinous substance very thin, and the bell cavity voluminous. In four of the specimens, including the largest, the entire subumbrella is so densely pigmented, except close to its aboral margin, that the manubrium is entirely hidden. In the others (pl. 2, fig. 1) the subumbrella surface is partially rubbed away.

Manubrium and gonads.—The manubrium, in all the examples, hangs to about the midlevel of the bell cavity; and it is attached to the subumbrella along the perradii for about four-fifths of its length (pl. 2, fig. 2). The lip, primarily cruciform, is thrown into many extremely complex folds. The gonads consist of a close network of ridges and corresponding depressions, which occupy the entire interradial areas. They do not connect with one another in the perradii below the attachment between manubrium and subumbrella, as they do in *P. conica*, but are discontinuous there (pl. 2, fig. 2). The ridges of the network are of different sizes, representing different periods of formation; and in the largest example, unfortunately a fragmentary one, they are exceedingly complex. Seen from within, the gastric wall is studded with prominences, corresponding to the hollows between the external ridges. In other words, the ridges are not simple thickenings, but are lines of outgrowth and folding.

Canal system.—The radial canals are proportionately broad and flat; their margins wavy, or jagged (pl. 2, fig. 5), and notched. In one specimen, the irregularities of their margins approach the condition in *Catablema vesicaria*, where they may be spoken of as diverticula; but there is considerable variation in this respect. The margin of the circular canal is smooth in such specimens as are well enough preserved to show it, including the largest one.

Tentacles.—As shown in the foregoing table, five interradial tentacles is the greatest number observed in any quadrant. If this number occurred in all four quadrants of any one individual, we should have a total of 24. But the condition varies from quadrant to quadrant in every example. Smaller specimens have fewer, 2–4, and tentacles were observed in various stages in growth.

Digitized by Google

The basal bulbs are large, conical, not laterally flattened, and clasp the exumbrella (pl. 2, fig. 4).

Color.—In the largest specimen the entire subumbrella is deeply pigmented, of a deep brownish-red, less opaque, however, than in *Meator rubatra*, the radial canals causing pale bands. The tentacles are of the same color, and manubrium, lips, and gonads are of a duller brownish-red, but equally strongly pigmented. In the specimen 47 mm. high the tentacles are faint reddish, but the pigmentation in this example is much paler in general, probably due to the poor condition of the subumbrella.

In two of the smaller specimens, which are in fair condition, the dense pigment ceases some distance above the margin, and is succeeded there by a clear zone, only faintly reddish next the radial canals, and with the tentacles colorless.

2. YOUNG STAGES.

Station.	Depth.	Height, mm.	Diameter, mm.	Interradial tentacles per quadrant.
4800 4764	221–0 1130–0	(?) 27	[1] 18 25	2, 2, 2, 3, 2, 3,

[1] Approximate.

In general form, voluminous bell cavity, and thin gelatinous substance, these small specimens agree very well with the large ones described above, and manubrium and lips (pl. 2, figs. 6, 7) are of the same type; but the gonads, as would be expected, are less advanced, the network being less prominent, the ridges lower, and the intervening hollows shallower. They are, however, of the same general structure, and it is especially interesting that they occupy the entire interradial regions just as they do in the larger specimens. Thus there is no evidence that the network is derived from a primarily horseshoe-shaped sexual swelling, as it is in *Pandea conica*. The margins of the radial canals are slightly wavy, that of the circular canal smooth.

There are fewer tentacles than in the large specimens, three being the most in any quadrant, with a total of 14 in the example shown in the photograph, but the conical basal bulbs are already well developed.

The pigmentation, instead of extending to the subumbrella as in the adult, is limited to the manubrium, which, with its lips and gonads, is of a deep brownish-red. This difference is a striking one; but the fact that the adults show a progressive development of pigment, which does not reach to the margin and tentacles until a height of 47 mm. is attained, is good evidence that the conditions in the two specimens now under discussion is merely an earlier stage in growth.

Digitized by Google

Genus CATABLEMA Haeckel, 1879. Maas, 1904 (Bigelow 1909c).

The three "species" listed in the genus by Haeckel, *vesicaria* A. Agassiz, *campanula* Haeckel, and *eurystoma* Haeckel, are undoubtedly identical, as Maas (1904*b*), Browne (1910), and I (1909*c*) have already pointed out. *Vesicaria* and *campanula* are successive stages in development; the only characters separating them are that the former has fewer tentacles, and usually has ocelli; but the first is a growth character, while I have myself found that the ocelli of *vesicaria* often disappear with preservation (*campanula* was based on alcoholic material). *Eurystoma*, with rudimentary stomach, is apparently only an abnormality. Mayer retains all three as distinct species (putting them in "*Turris*"); but gives no discussion of them.

Browne (1910) has recently added another species, *weldoni*, to the genus, from the Antarctic. But this form has gonads of the *Neoturris*[1] type, and therefore does not fall in *Catablema* as here defined.

The present collection contains a considerable series of *C. vesicaria* from Bering Sea which are perhaps sufficiently distinct from Atlantic specimens to be noted as a local variety. There are likewise four specimens which are distinguished from *vesicaria* by having upward of three times as many tentacles in both young and adult; by their large size, and by the form of the tentacular bulbs. Comparison with considerable series of the latter, both Atlantic and Pacific, shows that the differences are sufficient to separate them specifically. A *Catablema* with "many hundred" tentacles has been briefly described by Kishinouye (1910) from the Kurile Islands as *C. multicirrata*, and no doubt the four *Albatross* examples belong to it.

CATABLEMA VESICARIA A. Agassiz, var. NODULOSA, new variety

Plate 1, figs. 8, 9.

Dutch Harbor, May 25, surface; 14 specimens.

Type.—Cat. No. 31053, U.S.N.M.

In general form the specimens resemble the Atlantic examples of *C. vesicaria* which I have studied, having the same thick, rounded gelatinous swelling at the aboral pole. But the gonads and tentacle number are rather different from the usual type of the latter, though probably lying within its extreme range of variation.

The gonads, as defined by A. Agassiz (1865), by Maas (1904*b*), and by the writer (1909*c*), consist of a series of vertical folds in each interradius, becoming oblique or even transverse close to each perradius, and in two of the North Atlantic specimens I have observed a few irregular knobs and swellings near the lower end of the manubrium. In the Bering Sea series there is the same series of hori-

[1] *Neoturris*, new name, Hartlaub, 1911, p. 209.

Digitized by Google

zontal folds in the upper part of each interradius, but instead of being fairly regular and even, as they are in typical *vesicaria*, they branch and even anastomose, so that a very loose partial network results, and the folds are augmented in the lower part of the manubrium by numerous knobs and irregular swellings.

A comparison of photographs of the gonads of the two (cf. pl. 1, fig. 8 with Bigelow 1909c, pl. 30, fig. 3), will show the difference at a glance. If extremes only were taken, they would suggest two different species, but occasional Atlantic specimens approach the Pacific type so closely that there is no actual discontinuity between the two. In young specimens from the Pacific the folds are less irregular and branch little if at all, so that they resemble the usual Atlantic form more closely, but the knobs are already present in examples 9 mm. high. This type of gonad is present in all the specimens, though the degree of development of the knobs varies.

The tentacles are rather less numerous, and have basal bulbs of rather a different outline from those of the Atlantic specimens which I have seen.

In the following table tentacle number is given of a series including the largest and smallest specimens:

Height, mm.	Diameter, mm.	Interradial tentacles of all sizes per quadrant.	Total tentacles.
9	10	2, 3, 2, 3	14
10	10	2, 3, 3, 3	15
10	11	3, 4, 3, 3	17
10	13	4, 3, 4, 4	19
15	17	4, 5, 4, 4	20
19	19	5, 4, 4, 5	22
11	14	4, 5, 5, 5	23
20	21	5, 5, 6, 5	25

Thus the number increases with growth, but so irregularly that it is seldom that two quadrants of any individual have the same number of tentacular organs at exactly the same stages of growth.

It is hard to classify the tentacles by size, because there are all gradations from large ones to mere knobs, and the latter are present in the largest as well as in the smaller specimens.

The order of development of tentacles is successively radial, interradial, adradial, and subradial. But after the first three series have appeared the formation of additional tentacles is exceedingly irregular.

Atlantic examples of *vesicaria*, of about the same size as the largest Bering Sea specimens, have twice as many tentacular organs of all sizes. Thus, in a specimen 19 mm. high by 17 mm. in diameter, I counted 22 large and 20 small, and in another 18 by 14.5 mm. there were 37 large and 2 small. Haeckel (1879) records 36–48 tentacles as the final number.

Digitized by Google

The bases of the tentacles are less compressed than is usual in Atlantic *vesicaria*, narrower, and do not clasp the exumbrella to the same degree.

The margins of the radial canals are lobed as in *vesicaria;* the circular canal is slightly wavy.

Color.—In the preserved specimens tentacles and manubrium are pale yellow.

C. vesicaria is known from the coast of New England, from the Labrador current, Greenland, and Spitzbergen.

CATABLEMA MULTICIRRATA Kishinouye.

Catablema multicirrata KISHINOUYE, 1910, p. 24.

Plate 1, figs. 4–7.

Orca, Prince William Sound, Alaska, July 19; 2 specimens, both in good anatomical condition, though somewhat contracted. One is 29 mm. high by 33 mm. broad, the other 36 mm. broad.

Dutch Harbor, Unalaska Island, Bering Sea, May 25; 2 young specimens, both about 14 mm. high by 13 mm. in diameter.

In the smaller of the two adults, which is the least contracted, the bell is nearly cubical, and it is evident that in life there was a considerable apical dome, now represented by a much wrinkled and flattened gelatinous cap.

Manubrium and gonads.—The manubrium, like the bell, is cubical, nearly fills the cavity of the bell, and is attached to the subumbrella along the perradii (pl. 1, fig. 4). The gastric portion of the manubrium hangs below the midlevel of the bell cavity, and the lip, primarily quadratic, is complexly folded, much more so than in any recorded specimen of *vesicaria,* either Atlantic or Pacific. The gonads consist of four series of folds, occupying nearly the whole of the four interradial areas, but entirely discontinuous in the perradii, even below the level to which the manubrium is attached to the subumbrella. In the center of each interradius the folds are vertical; near the perradii they become somewhat oblique, just as in *vesicaria,* but in no instance were they transverse. In the interradius shown in the photograph (pl. 1, fig. 4) there are 25 folds. The folds vary in breadth and in length, but in neither example are they supplemented by the irregular knobs and swellings which are a prominent feature in the gonads of the Pacific form of *C. vesicaria.* The ridges are simple folds of the gastric wall, not thickenings, and the sexual products, large ova in both specimens, are developed indifferently over the ridges and in the valleys which separate them. But few if any ova are to be seen below the level at which the ridges terminate, and none at all along a rather broad band marking each perradius.

Canals.—The canals, both radial and circular, are very broad (pl. 1, fig. 5). Owing to the large size of the manubrium, the radial

Digitized by Google

canals are very short from the margin and their attachment to the latter, less than twice as long as broad. Their margins are very irregular, jagged, or with broad, dendritic diverticula, the exact outlines varying from canal to canal. The margin of the circular canal is strongly jagged.

Tentacles.—The most distinctive character of the species is afforded by the very large number of tentacles and by the form of their basal bulbs. In the smaller specimens there are 34 and 41 tentacles in two successive quadrants, and the total is about 150. In one of the large ones the number of interradials to the quadrant is 43, 39, 34, 41; the total about 155. And even these large numbers are not, it seems, the final ones, for there are many young tentacles in various stages of development, besides minute knobs which have just commenced their growth. As is usual in Pandeids with large numbers of tentacles, these organs seem to be in two or more rows. But examination shows that this is only apparent, being due to the outward growth of the bases of the older tentacles (pl. 1, fig. 6).

In *C. vesicaria* the largest number of tentacles, old and young, which has ever been recorded, is only 48, and the numerous records of that species show that even this number is seldom attained.

The basal bulbs are of a characteristic outline (pl. 1, fig. 6), laterally flattened, triangular, and extending outward over the exumbrella. The bulbs of *vesicaria* are likewise triangular, but while in the latter species the axis of the filament lies at the inner face of the triangle, and the outward growth is in the form of a spur, in *multicirrata* the axis is opposite the center of the base of the triangle.

Color.—In the preserved condition, manubrium and tentacles are pale brownish-yellow.

The two young specimens are interesting because they show that this species is readily distinguished from *vesicaria* at an early age. The gelatinous dome, contracted in the adult, is well preserved here. The other differences between them and the latter are all such as would be expected; that is, fewer tentacles and less prominent gonads. The manubrium is proportionately shorter, and its perradial attachments to the subumbrella do not extend so far. The gonad folds are very short, occupying only a narrow zone at the upper part of each interradial area, and the lips are simpler. On the other hand, the margins of the circular and radial canals are nearly as irregular and as complexly lobed as they are in the adult.

The marginal organs consist of tentacles in every stage of development. The numbers of interradials of all sizes to the quadrant in one specimen are 25, 26, 21, 20, a total of 92, and in the other 24, 25, 24, 28, the total being 101. Of these, 41 in the former and 46 in the latter are minute knobs; and every stage is present connecting these with large tentacles.

Digitized by Google

This stage of *multicirrata* is readily distinguished from *vesicaria*, as is the adult, by the very large number of tentacles, for in the latter, at about the same stage of sexual development, there are usually only 16–28 tentacular organs of all sizes. Furthermore, the gonads are much farther advanced in *vesicaria* of the same size.

Family BYTHOTIARIDAE Maas, 1905.

[For discussion of this family see Maas (1905, 1910) and my earlier paper (1909*a*).]

Genus CALYCOPSIS Fewkes, 1882.

The credit for pointing out that my *Sibogita nauarchus* is a synonym of the insufficiently described and long-forgotten *Calycopsis typa* Fewkes is due to Dr. A. G. Mayer (1910, p. 491), and Vanhöffen (1911, p. 214) has likewise adopted this identification. To clinch the matter I have examined the type-specimen of Fewkes's species, now in the United States National Museum, finding that it agrees with my material even to minor details.

The following species of *Calycopsis* have been described: *typa* Fewkes (=*nauarchus*), *simulans* Bigelow, *chuni* Vanhöffen, *borchgrevinki* Browne, and *bigelowi* Vanhöffen, all closely allied to each other. The first three are known from large mature individuals, so that we have a fairly definite idea of their final state of development, but the last two have been described from small examples, not necessarily immature, however.

Vanhöffen (1911) in his survey of the genus has laid especial stress on the regularity of the sexual folds and on color as specific features; but there is another character which proves of greater value, the number of tentacles and their relation to the canals. Using this as a criterion, we find that in *typa* and in *simulans* there are about as many tentacles as canals, or to be more precise, tentacles are formed first, but the corresponding canals shortly follow. Thus there are often more tentacles than canals, but apparently every tentacle is eventually associated with a canal. In *chuni* there are about twice as many canals as tentacles. Three specimens have been described as *simulans*, two from the eastern tropical Pacific, one from Bering Sea, and the latter, having 30 tentacles and only 16 canals, might seem to be an exception to the above statement. But, as I shall show, I made an error in identifying this individual as *simulans;* in reality it probably belonged to a new species, *nematophora*, represented in the collection by an excellent series.

Vanhöffen has united *typa* and *simulans;* and unquestionably they are more closely related to each other than is either of them to *chuni*. But apart from the terminations of the canals—that is, whether or not they are permanently blind in *typa* instead of finally joining the base of the manubrium—there is one feature, minor it is

Digitized by Google

true, which distinguishes the Atlantic specimens of *typa* from their Indian Ocean representative (Vanhöffen) and from *simulans;* that is, the presence of a funnel-shaped apical depression in the former and its absence in the latter. I should not lay stress on this, were it not that Fewkes's example of *typa* shows it very clearly. And when specimens from the same general locality, but captured some 30 years apart, have so trifling a character well developed, it can hardly be looked on as an individual variation. The probable explanation is that *typa*, a form of very wide distribution, has local varieties. And this is not at all an unreasonable assumption, since it is probable that *Calycopsis*, though belonging to the Mesoplankton, has a fixed stage. *C. chuni* is distinguished from *typa* not only by the number of tentacles, but by a less regular arrangement of the genital folds, and, according to Vanhöffen, by the red color of its tentacles.

In *borchgrevinki*, according to both Browne (1910) and Vanhöffen (1911), there are 8 canals, 4 radial, and 4 interradial centripetal, and up to 16 tentacles. The gonads are restricted to the upper part of the manubrium. In small specimens, 10–18 mm. high, the genital products suggest transverse folds (Vanhöffen), but in large ones, 20 mm. high, they lie in irregularly arranged pockets (Browne), though probably the difference is one of terms of description only. Vanhöffen (1911) has suggested that *borchgrevinki* is a young stage of *typa*, stating that the restriction of the sex products to the base of the manubrium is evidence of immaturity. But this does not necessarily follow. On the contrary, the fact that all the specimens of this species agree in their general stages of development, though taken at far separated localities (south of Bouvet Island, and near Cape Adare), and especially that Browne (1910) observed large ova, as well as gonads emptied of their contents, suggests that we are dealing with a small, simply organized Antarctic species. If not, advancing development would seem to lead, not to *typa*, but to a stage resembling *bigelowi*, which agrees with *borchgrevinki* in having more tentacles than canals, and in the number of canals. It is true that it has more tentacles (about 48, large and small, in the one known specimen), and that the gonads are transversely folded, but both these features would naturally result from progressive development of *borchgrevinki*. Whether these two "species" are finally united, more extensive material alone can show.

In the several species of *Calycopsis* so far considered, the lip, though more or less folded, has a smooth margin without projections or papillae of any kind, but in a series in the present collection it is not only extensively folded, but is studded with a marginal row of stalked nematocyst knobs, a structural character so distinctive that it alone would warrant the institution of a new species. And the structure of the gonads is likewise characteristic. In the proportionate number

Digitized by Google

of canals and tentacles, the new species, *nematophora*, falls with *borchgrevinki* and *bigelowi*. The Bering Sea specimen which I referred (1909) to *simulans* probably belonged to *nematophora* because of the numerous tentacles. Its geographic origin likewise points in that direction, but unfortunately the lip is badly damaged.

CALYCOPSIS NEMATOPHORA, new species.

Plate 2, fig. 8; plate 3, figs. 1–3.

The series gives the following data:

Station.	Depth, fathoms.	Height.	Flattening.	Canals at margin.	Large tentacles.	Small tentacles.	Total.
4785	300–0	25	None.	16	16	16	32
4786 Type.	300–0	22	Interradial.	17	6	30	36
4766	Surface?	21	Interradial.	18, 1 blind.	8	31	39
4763	300–0	17	Interradial.	16	16	27	43
4764	1130–0	20	Interradial.	16	9	33	42
4793	300–0	Diam. 29.	Radial.	16	16	32	48
4766	Surface?	17	Interradial.	16	8	40	48
5028	Surface?	31, × diam. 30.	Interradial.	17	16	41	57

Type.—Cat. No. 31054, U.S.N.M.

At stations 4773, 338 fathoms to surface, and 4804, 229 fathoms to surface, one specimen each was taken, but they were too battered for counting the tentacles. Also Bering Sea, July, 1890 (station 3307), surface, 21 specimens in alcohol, much contracted, now about 15 mm. high; Bering Sea, August, 1895 (station Hyd. 3629), surface, 4 specimens in alcohol, much contracted.

The specimens are of the usual "*Calycopsis*" outline, rather higher than broad except when contracted, and most of them laterally flattened. But inasmuch as the flattening may be either radial or interradial, and as one example is not flattened at all, this character is probably the result of temporary contraction or of preservation, as it is in *C. typa* (Bigelow, 1909*b*).

It is interesting that several of the specimens have a slight funnel-shaped apical depression. These being the best preserved examples, and those in which it is lacking being somewhat damaged in that region, it is probable that the depression is a normal feature. But it is neither as deep nor as narrow as it is in *typa* (Bigelow, 1909*b*, pl. 30, fig. 1).

Manubrium.—The manubrium is barrel-shaped; separable into well-defined basal, gastric, and labial portions. When expanded it is about as long as the bell cavity is deep; but in several examples it is very much contracted.

Gonads.—In *C. typa*, *C. simulans*, and *C. bigelowi* the gonads consist of double series of very regular folds; and in *C. chuni* they are of the same general type though less regular (Vanhöffen, 1911). In *nematophora* they are rather different, for the two series of folds are less

Digitized by Google

precise and less crowded, and they are supplemented by a number of intervening folds at least over part of the manubrium (pl. 2, fig. 8), though the gonads as a whole show considerable variation in different specimens, and even in different interradii of a given specimen. The difference between this gonad-type and that of the *typa-simulans* group is so striking that this character alone is sufficient to separate them. But the lip affords an even more diagnostic feature. In all the other members of the genus this structure is simple, quadrate, but slightly folded, if at all, with a smooth margin (Bigelow, 1909*b*). In *nematophora* it is extremely extensible; capable of being thrown into complex folds, and, most important, its margin is thickly set with a very large number of stalked nematocyst knobs (pl. 3, fig. 3).

Canal system.—The specimens are all far advanced in development, and in most of them all the canals are united with the cruciform base of the manubrium. But in one, from station 4766, 21 mm. high, one of the 18 canals is still blind, and reaches only to about one-third the height of the bell cavity, and in another there are two very short blind canals close together (pl. 3, fig. 1). In several instances two canals unite, the union being either close to the margin or higher, and in one instance a canal bifurcates close to the margin, the two resultant trunks reuniting just below the base of the manubrium; furthermore, canals may be connected by a transverse bridge, as also happens in *C. simulans* (Bigelow, 1909*b*). Evidence of the readiness with which canals may send out such branches is afforded by the fact that their margins, particularly near the circular canal, are sometimes jagged (pl. 3, fig. 1), sometimes smooth. The position of each canal corresponds to the center of a longitudinal band of subumbral muscle fibers (pl. 2, fig. 8). No such condition has ever been observed in any of the specimens of *Calycopsis* previously studied.

Tentacles.—As a rule every canal which reaches the margin of the bell is associated with a tentacle; but in the specimen noted above the two short centripetal canals bear no definite relation to the neighboring tentacles. This fact suggests that these canals are merely sporadic outgrowths from the circular canal, and that they would never have attained much greater length. Judging from this, we must assume either that tentacles precede canals in development or that the number of canals present, 16–18, is about the final one, and that the intermediate tentacles would never be associated with canals.

The different sizes of the canalar tentacles gives us an idea of the relative ages of the canals with which they are associated. Thus in one example only 4 of the canals have large tentacles, 12 have small ones, and if we follow the series through, from the data given above, we find a specimen with 6 large and 11 small; 2 with 8 large, 8 and 10 small—that is, large and small roughly alternating (pl. 3,

Digitized by Google

fig. 1)—and 3 in which all the canals,16 in each case, are associated with large tentacles. In general, then, we may assume that after the 4 primary radial canals, 4 more, and then a third series of 4–6 more, are formed.

In addition to the canalar tentacles every specimen has a large number of tentacles which alternate with the canals. In the youngest example, age being judged by the condition of the canalar tentacles, there are only 16 of these—that is, 1 between every 2 canals. They increase irregularly in number, and in the older specimens there are usually 2, often 3, between each pair of tentacles. The largest number is 41, in an example with 17 canals.

The fact that the increase of tentacles so far outstrips that of canals—the latter, indeed, being almost stationary—indicates that the canals have probably nearly or quite attained their final number. Except for size, the tentacles are structurally all alike, there being no very young ones in any of the specimens. Each has a large terminal nematocyst knob which is spherical, instead of pear-shaped, as it is in *typa*. The older tentacles curve upward at first, and lie in furrows of the exumbrella, just as in other members of the genus, but the younger ones project directly from the margin, the course of development in this respect being precisely what it is in *typa* (Bigelow, 1909*b*).

Color.—No color notes were made from life. After preservation the gonads are pale brownish-red. But it should be noted that specimens of *typa* in which these organs are a very deep chocolate in life fade to the same pale tint after preservation in formalin.

The localities of capture are restricted to the Bering Sea region and the Sea of Okhotsk.

Genus HETEROTIARA Maas, 1905.

Two species of *Heterotiara*, *anonyma* Maas and *minor* Vanhöffen, have been described, and my own examination of considerable series of both (*minor* from the Philippines) shows that they are undoubtedly distinct. They are separated by the number of tentacles correlated with size, *anonyma* having 12 tentacles (or less) when adult, and reaching a height of 20 mm.; whereas *minor* has about twice as many tentacles, though much smaller (only about 10 mm. high). The Philippine series of *minor* will be described elsewhere. The present collection contains an excellent series of *anonyma*, a species previously known from four specimens only.

HETEROTIARA ANONYMA Maas.

Heterotiara anonyma Maas, 1905, p. 19, pl. 3, figs. 19–21.—Bigelow, 1909*a*, p. 216, pl. 41, figs. 12, 13.—Vanhöffen, 1911, p. 211, pl. 22, figs. 3, 4.

Digitized by Google

The series gives the following data:

Station.	Depth, fathoms.	Height.	Diameter.	Interradial tentacles per quadrant.	Total number of tentacles.
4797	300-0	21	13	0, 1, 1, 1	7
4766	(?)	18	13	0, 1, 0, 1	6
4793	300-0	12	10	0, 2, 1, 0	7
4767	771-0	20	15	0, 1, 2, 1	8
4763	300-0	21	12	1, 0, 1, 1	7
4775	200-0	13	12.5	1, 1, 1, 1	8
4759	300-0	(1)	12	1, 1, 2, 2	10
4759	300-0	Too shriveled to study.			

[1] About 13 contracted.

Most of the specimens are in such excellent condition that I can add some details to the previous accounts of this interesting species. The high, domed outline, with thick gelatinous substance, is characteristic, as is the deep, rather narrow bell cavity. The precise proportions of the bell vary, but when not contracted it is always considerably higher than broad.

The manubrium is more or less contracted in all the examples. In one specimen, in which large ova are visible, the gonads are slightly wrinkled; in three others, apparently males, the contraction takes the form of more regular folds. In all cases the sexual masses occupy the entire interradial areas, from the base of the manubrium to close to the lip; but there is no sexual development in the perradii. One specimen, the smallest, has no gonads, and in two others the manubrium is lost. Transverse folding of the gonads, due to contraction, is also usually present in the closely allied *minor*. But in one of the eastern Pacific specimens of *anonyma*, a female, the manubrium was smooth (1909*a*, pl. 41, fig. 13). This fact together with the irregularity of the folding, is good evidence that it is not normal.

Tentacles.—The *Siboga* and the *Valdivia* specimens had 8 tentacles; the two eastern Pacific examples 11 and 12, respectively. Vanhöffen has suggested that the large number of tentacles in the latter was evidence that they did not belong to *anonyma*, but the present series shows that the number is variable, and that it varies independently of size. Thus the two specimens 21 mm. high have only 7 tentacles each, while specimens of 13 and 20 mm. have 8, and one which, judging from its diameter, was probably about 20 mm., has 10. Quadrant by quadrant, as well as from individual to individual, the tentacles vary in number. Occasionally there is no interradial tentacle in a quadrant; usually there is 1, sometimes there are 2; but a larger number has never been observed, and consequently we have reason to believe that a total of 12 is the normal limit in this species, one, however, not often attained. No young tentacles have ever been observed in *anonyma;* but whether this is merely a coincidence or whether it means that the final number for any individual is attained

Digitized by Google

at an early stage in growth can not be answered from the evidence yet at hand.

The tentacles are as long as the bell height, or longer, when expanded, but they are usually contracted, and many of them are broken short off. Each of those which remain intact bears a spherical terminal nematocyst knob much as in *H. minor*.

The specimens are colorless.

The previous localities for this species are the Humboldt current off the coast of Peru, the Malaysian region, and the Indian Ocean, near Nias Island. All the records are from "intermediate" hauls.

Order LEPTOMEDUSAE.

Family LAODICEIDAE, L. Agassiz, 1862 (Browne 1907).

Genus STAUROPHORA Brandt, 1838.

Mayer (1910), in his discussion of *Staurophora*, has pointed out the necessity of comparing specimens from the Pacific with material from the Atlantic, to settle definitely whether the two are identical. This I am able to do, thanks to an example from Bering Sea, several from Prince William Sound, and Atlantic specimens from New England and from Newfoundland, with the result that I have been unable to find any differences sufficient to separate them.

The recent record of *S. mertensii* ("*laciniata*") by Vanhöffen (1911) from the Indian Ocean is very interesting, not only in extending the range of the species from the Arctic to the Tropics, but also for bearing on the *Staurophora* described by Browne (1902, 1908) from the Falkland Islands, *S. falklandica*. This species is evidently a close relative of *mertensii*, the only difference being that the small tentacles of the single specimen lack ocelli, and it is very desirable that more extensive material of *falklandica* be studied to show whether, as Mayer suggests, the small (young) tentacles might develop ocelli later. Hardly any species would have been more of a surprise in the Tropics, because many years' observations have shown that *Staurophora* is limited to cold waters in its distribution along the American and European coasts of the north Atlantic. But Vanhöffen had North Sea specimens at hand for comparison.

STAUROPHORA MERTENSII Brandt.

Staurophora mertensii Brandt, 1838, p. 400, pls. 24, 25.
Staurophora laciniata L. Agassiz, 1849, p. 300, pl. 7, figs. 1–15.
Staurostoma arctica Haeckel, 1879, p. 149.
(For further synonymy, and a full discussion of the genus and species, see Mayer, 1910, p. 291.)

Dutch Harbor, May 25, surface; 4 young specimens, 8–15 mm. in diameter.

Digitized by Google

Prince William Sound, Alaska; 5 large specimens, 50–60 mm. in diameter; in fragments.

Although the large specimens are broken into segments, both they and the small ones are in good anatomical condition, and I have been able to compare them with Atlantic examples of corresponding sizes, without finding anything to separate them.

Genus PTYCHOGENA A. Agassiz.

Six "species" of *Ptychogena* are now known, among which the Arctic *P. lactea* is distinguished by the great breadth and shortness of its gonads and by the regularity and length of the diverticula of the radial canals along which they are developed. In adults of this species the sexual mass as a whole is about as broad as it is long, and it is restricted to the middle ⅓ of the radial canals; while in all the other species—that is, *longigona* Maas, *erythrogonon* Bigelow, *californica* Torrey, *hertwigi* Vanhöffen, and *antarctica* Browne—it is spindle-shaped. None of the latter species is known from more than a few specimens, and it is possible that some of them may be found to merge into one another.

The collection contains a series which differ from *lactea* only in having fewer tentacles than were described first by A. Agassiz, and as the gonads show that they are less advanced in development than any of the specimens of that species yet recorded, and as the series shows that tentacle-number increases with growth, I have no hesitation in referring them to *lactea*.

PTYCHOGENA LACTEA A. Agassiz.

Ptychogena lactea A. Agassiz, 1865, p. 137, figs. 220–224.

(For synonymy, see Mayer, 1910, p. 215.)

Station 4767, 771–0 fathoms; 1 specimen.
Station 4769, 244–0 fathoms; 1 specimen, 30 mm. in diameter.
Station 4793, 300–0 fathoms; 1 specimen, 30 mm. in diameter.
Station 4803, 299–0 fathoms; 1 specimen.
Station 5030, 300–0 fathoms; 1 specimen, 45 mm. in diameter.
Station 5043, 300–0 fathoms; 1 specimen.

These stations are all in Bering Sea and in the Sea of Okhotsk, except for 5043, which is off the east coast of Hokkaido, Japan.

The specimens are more or less flattened and the margins are damaged; otherwise they are in good condition. The descriptions by Agassiz (1865) and by Haeckel (1881, "*pinnulata*") are so complete that the only points needing discussion here are the changes which the gonads undergo with growth and the number of marginal organs.

Gonads.—In the largest specimen, a female, 45 mm. in diameter, the gonads are large and full of large ova. A view from the exumbrella

Digitized by Google

side agrees very well with Haeckel's figure (1881, pl. 2, fig. 1), the folds and the corresponding transverse diverticula of the radial canals being very regular, about 20 on each side, and so long that the organ as a whole is of a broad oval form; it occupies little more than the central ⅓ of the canal. The free subumbrellar edges of the folds are neither scalloped, as Haeckel represented them, nor perfectly smooth, as in A. Agassiz's figure, but sometimes smooth, sometimes irregularly wavy or lobed; that is, they are intermediate between the two extremes, as were Linko's examples from Barents Sea.

A much contracted specimen, now about 30 mm. in diameter, has younger gonads, with only about 15 folds on each side, and the folds so much shorter that the whole organ is lanceolate. A still earlier stage is to be seen in the specimen from station 4793, likewise 30 mm. in diameter, but fully expanded, so that this is about life size, and this specimen is especially instructive, for two of the gonads illustrate as many successive steps in development. In the younger the radial canal is somewhat dilated in the region of the future sex organ, and there are eight or nine short lateral branches on each side—the proximal ones minute, the more distal longer. The gonad tissue is, so far, only a slight thickening of the walls of the diverticula. In a further developed gonad there are about twice as many lateral branches on each side of the radial canal, the ones in the middle being the longest, the proximal ones obviously more recently formed, and the sexual thickenings now extend from the distal end to the mid-region.

Tentacles and cordyli.—In the youngest specimen there are 13, 11, and 9 subradial tentacles, in three successive quadrants—that is, a total of about 50; and from 1–8, usually 4 or 5, cordyli between each pair of tentacles, with about 40 in the only quadrant in which they could be counted, or a total of about 160. In the somewhat older specimen with intermediate gonads there are 11 and 16 tentacles in two quadrants, and in the latter the tentacles are crowded. In the largest and oldest specimen the number of tentacles is much greater. In two quadrants there are 27 and 32—that is, a probable total of about 125, of various sizes, some obviously very young; and the presence of a considerable number of minute tentacular knobs suggests that a much greater number of tentacles would have been attained eventually. There are from 1–3, often 2, cordyli between every two tentacles or knobs; thus the number of cordyli does not keep pace in its increase with that of tentacles. In Haeckel's specimens, 50–60 mm. in diameter in alcohol, but no doubt still larger in life, there were 200–300 tentacles, with about the same number of cordyli; and in the large examples described by A. Agassiz (1865) the cordyli alternate with the very numerous tentacles.

Digitized by Google

Whether or not the bases of the tentacles are laterally compressed depends on how crowded they are; in our intermediate specimen they are noticeably flattened, in the largest hardly at all so. This may be partly individual variation, partly accidental.

The previous records of *P. lactea* are from Massachusetts Bay (A. Agassiz), off the coast of Nova Scotia (Haeckel), between Iceland and Ireland (Haeckel), west coast of Greenland (Levinsen), and Barents Sea (Linko).

Family MITROCOMIDAE Haeckel (Torrey, 1909; Browne, 1910).

Family LAFOEIDAE Maas (1905).

Mayer (1910) does not recognize the structure of the sense organs as a family character; but like Maas (1905), Torrey (1909), and Browne (1910), I believe that the group characterized by open sense-pits in the velum is a natural one, and, as Torrey has pointed out, the best available name is Mitrocomidae.

Among the interesting "finds" of the collection is the discovery that the large conspicuous medusa so common in Puget Sound, first described by A. Agassiz as *Laodice cellularia*, and recently redescribed from mature specimens by Murbach and Shearer (1903) as *Thaumantias cellularia*, has open sense pits in the velum, and therefore is not a *Thaumantias* at all, but belongs to the Mitrocomidae. But it does not fit in any of the genera of the family recognized by Browne (1910), for though it has numerous sense pits without ocelli, like *Mitrocoma*, it differs from the latter in lacking marginal cirri. And inasmuch as there are at least four species of *Mitrocoma*, as well as one of *Mitrocomella* with cirri, the difference warrants the establishment of a new genus, *Halistaura*. Except for the sense-organs, our series agrees with the earlier accounts of *cellularia* even to minute details.

HALISTAURA, new genus.

Mitrocomidae with 4 radial canals; with numerous open sensory pits; without marginal cirri.

Type.—*Halistaura cellularia* A. Agassiz.

HALISTAURA CELLULARIA (A. Agassiz).

Laodice cellularia A. Agassiz, 1865, p. 127, figs. 195, 196.

Thaumantias cellularia Haeckel, 1879, p. 129.—Murbach and Shearer, 1903, p. 172, pl. 17, fig. 2, 2*b*.—Mayer, 1910, p. 199.

Station 4754, off Southern Alaska, October, 1905, surface; 7 specimens 40-50 mm. in diameter. Also several specimens from Puget Sound.

None of the specimens are perfect, most of them being flattened out, but several of them are in sufficiently good anatomical condition for individual quadrants of the margin to be studied.

The descriptions of this species by L. Agassiz and by Murbach and Shearer cover two successive stages in its development, the former

Digitized by Google

being of specimens about 30 mm. in diameter, with a hundred tentacles, the latter of ones 50–90 mm. broad, with about 340 tentacles. The present series is intermediate between the two: 35–50 mm. in diameter, with 69–81 tentacles to the quadrant, a total of from 200–250.

The earlier accounts are so detailed and the figures so satisfactory that there is little to be added, except an account of the otocysts. I may note, however, that a very short manubrium, with long, crenulated lips, gonads extending over most of the length of the radial canals, swollen cylindrical tentacular bulbs, and entire absence of cirri, prove to be constant characters. The present specimens are flatter than those previously recorded, but the difference may be due to preservation.

Sense pits.—The sense pits are not associated with ocelli, thus resembling those of *Cosmetira* and *Mitrocoma*, and differing from the corresponding organs in *Tiaropsis*. For this reason, and because, at least in formalin material, they lack otocysts which might attract attention by their high refrangibility, they are very easily overlooked. Indeed, it was not until I examined a specimen under the compound microscope that I suspected their presence, although they are so large that once located their "open" nature is easily made out with a hand lens. Their inconspicuous nature is of course the reason that they were not observed by earlier students. As in *Mitrocoma*, they are simple pits or pockets in the velum, the opening being on the subumbrella side, lying close to the marginal ring. Their number is variable; in one quadrant (with 79 tentacles) there were six, in another (81 tentacles) only three; in a third, six in the two-thirds which is intact, and in one quadrant, which was well preserved, I could find none. I could not count them over the whole margin of any specimen. Judging from these quadrants, we may assume, tentatively, a total of 12–24. Structurally the pits closely resemble these of *Mitrocoma* (O. and R. Hertwig, 1878, pl. 7, fig. 14), except that no otoliths could be found. As is seen in cross section the pits are flatter than a hemisphere, and the exumbrellar ectoderm covering them consists of high, columnar cells, which merge into the much smaller cells of the exumbral surface of the velum at the outer margin, while centrally they merge into the marginal ring. A very thin "stuzlamella" separates these large cells from the much smaller ones composing the subumbrellar layer, clearly visible in optical sections. It is in this layer, of course, that the otoliths are to be sought, but no such structures can be found. The only thing suggesting that they were present in life, but have been destroyed by the formalin in which the specimens are preserved is that the cells of the subumbrellar layer, within the pit, are occasionally replaced by large, irregular masses which may be the remnants of the otolith cells.

Digitized by Google

Genus TIAROPSIS L. Agassiz.

The species of *Tiaropsis* fall into two distinct groups, one with very numerous tentacles all alike, the other with four or eight large tentacles and a considerable number of rudimentary subradial tentacular bulbs. The latter group consists of *rosea* Agassiz and Mayer, *mediterranea* Metschnikoff, and *kelseyi* Torrey, all of them tropical or at least warm water forms, which therefore need not concern us here. The first group, comprising *diademata* L. Agassiz, *multicirrhata* Sars, *maclayi* von Lendenfeld, and *davisii* Browne, belongs to the colder waters of both hemispheres, and its members are very closely allied to one another. *Diademata* and *multicirrhata* are separated only by the fact that ocelli are said to be present in the latter, absent in the former. (For details, see Mayer, 1910, p. 259.) The fact that *diademata* lacks tentacular ocelli has been established on great numbers of specimens, but the tentacular bulbs are not altogether without pigment, for in all the numerous specimens which I have studied they contain a small amount of entodermic pigment of a pale greenish or yellowish-brown color, which is visible only when the animal is studied against a white background. Now, the various figures of the north European *multicirrhata* by no means establish the presence of tentacular ocelli; all they show is the presence of the same entodermic pigment, only in much denser masses, and black instead of pale greenish. Thus the distinction between the species is not an organic one, being nothing but a question of the density and color of the pigment masses.

Under these circumstances it would not be at all surprising if intermediates should turn up, and as a matter of fact the specimens described below have denser tentacular pigment than is usual in *diademata*, though it is of the same color. On the whole it seems to me likely that *diademata* and *multicirrhata* are the extremes of a single varietal series, but I hesitate to unite them unequivocally without having had an opportunity to study specimens of the latter. It is interesting in this connection that the bases of a few, but not all, of the tentacles of the Australian *T. maclayi* are pigmented. It is impossible to determine at present just what relationship the latter species bears to the northern forms, because the figure (von Lendenfeld, 1884, pl. 23, fig. 37) is diagrammatic, and the description in very general terms. But it is apparently distinguished by having small, instead of large, crenulated lips. *Davisii* is apparently closely allied to *maclayi*, but without a figure or a detailed description I hesitate to make a definite assertion.

The present collection contains a considerable series which I have compared, side by side with numerous large and well-preserved

Digitized by Google

diademata from Newfoundland, without finding a single character to separate them except in the density of pigmentation.

TIAROPSIS DIADEMATA L. Agassiz.

Tiaropsis diademata L. AGASSIZ, 1849, p. 289, pl. 6, figs. 1–16; pl. 8, fig. 11.
(For further synonymy, see Mayer, 1910, p. 258.)

Dutch Harbor, May 25, surface; 22 specimens, 10–22 mm. in diameter.

Agattu Island, June 7, surface; 8 specimens, 18–20 mm. in diameter.

The material is in excellent condition.

For the sake of identification, of course, one of the first questions to be answered was to what extent the bases of the tentacles were pigmented. In the specimens from Agattu Island they are apparently colorless, seen by transmitted light, though opaque. But when studied against a white background it is evident that the entoderm of each bulb contains pale greenish, or in some cases greenish-brown, pigment, in a roughly triangular mass. Though the pigment is of the same color that it is in the Atlantic *diademata*, it is rather more dense than I have observed it in the latter, but in none of the specimens is it black, as it is represented in *multicirrhata*. I was surprised to find that in the Dutch Harbor series there was no pigment to be seen in the bulbs; but as the preservation in these was not quite so successful, I do not feel certain that there was none in life. It may have faded as it so often does in medusae.

In a specimen 20 mm. in diameter there are 59, 64, 65, and 62 tentacles in the four quadrants, a total (with four radials) of 254, all large. In a smaller one of about 15 mm. the numbers are 37, 38, 39, 42, total 160, among which large and small roughly alternate. In a specimen from Newfoundland of 20 mm. the total number is 256, all large; apparently, then, the final number is about 250, which is rather more than Mayer (1910) credits it with.

In the length of the gonads, frilled lips, and short broad peduncle the series agrees perfectly with Atlantic specimens.

T. diademata has been recorded from the coasts of New England and Newfoundland, where it is often very abundant; Greenland, and from the White Sea (Linko, 1899); it is therefore not surprising to find it in Bering Sea.

The more deeply pigmented *multicirrhata* (whether species or variety) is known only from the northwestern coasts of Europe.[1]

[1] Since the above was written I have studied excellent specimens from Massachusetts Bay in which the tentacular bulbs were densely pigmented with black granules, thus exactly reproducing the European type.

Digitized by Google

Family EUCOPIDÆ Gegenbaur, 1856.

Genus OBELIA Péron and Lesueur, 1809.

The collection contains two mature medusae of *Obelia*, a male and a female, each with about 128 tentacles. It is, of course, impossible to identify these without any knowledge of the hydroid from which they were released.

OBELIA, species ?

Dutch Harbor, Alaska, May 25, surface; 2 specimens.

Genus EUTONINA Hartlaub, 1897.

Eucopidae with eight adradial otocysts, with a peduncle, with numerous tentacles, but seldom with marginal cirri or warts.

Mayer uses the name *Eutimium* Haeckel for this group (he, however, does not include the number of tentacles as a generic character), but the type species of that genus, *E. elephas* Haeckel, was beyond question a *Eutima*. I formerly used the name *Eutimalphes;* but *Eutonina* seems to have the better claim, because its type species is well known, while that of *Eutimalphes*, *E. pretiosa* Haeckel, was founded for a fragmentary specimen which may have been a *Tima*. It has never been seen since first recorded.

The question whether *E. indicans* Romanes and *E. socialis* Hartlaub are distinct is still open. Mayer believes that they are probably identical, and I can see no good reason for separating them. On comparing the figures of the two, the only apparent difference, as Hartlaub (1897) himself pointed out, is that *socialis* is flatter than a hemisphere, while *indicans*, in Romanes's (1877) figure, is considerably higher than broad, though according to the original account it is hemispherical; but the figure is obviously imperfect in that the gelatinous substance is entirely omitted, and when we consider that *indicans* agrees with *socialis* in all other respects—that is, length of peduncle, structure of gonads, number of tentacles, number of otocysts, and even number of otoliths (12) to the otocyst—the reasonable conclusion is that the figure of *indicans* was drawn from a specimen in systole; that is, when fully contracted, as in normal swimming. Similar outlines could readily be sketched for even flatter medusae, as, for instance, *Phialidium*. The two are therefore combined here as *indicans*.

EUTONINA INDICANS (Romanes) Hartlaub.

Tiaropsis indicans ROMANES, 1876, p. 525; 1877, pl. 15, fig. 1.
Eutimalphes indicans HAECKEL, 1879, p. 195.—HARTLAUB, 1894, p. 194.
Thaumantias, sp. MCINTOSH, 1889, p. 282, pl. 5, figs. 6–9.
Eutonina indicans HARTLAUB, 1897, p. 507.
Eutonina socialis HARTLAUB, 1897, p. 506, pl. 20, figs. 19, 20; pl. 22, figs 3, 4, 6, 7.

Digitized by Google

Dutch Harbor, May 25, surface; 15 specimens, 25–35 mm. in diameter; well preserved.

The identification rests on comparison with two excellent specimens from Helgoland. In the largest of the Bering Sea specimens, about 35 mm. in diameter, the number of tentacles to the quadrant is 43, 49, 43, 42, of various sizes, a few being very young, but the greater number full grown. In one of 30 mm. the numbers are 39, 37, 36, 36, besides 11 marginal swellings still too young to be dignified with the name of tentacles. In an Atlantic specimen of 28 mm. the numbers are 48, 41, 45, 42, and the total number is given by Hartlaub as about 150.

The only noticeable separation between examples from the two localities is that in those from Bering Sea the gonads begin close to the base of the peduncle, instead of at a slight distance from it, as in the Helgoland specimens, but the difference is so slight that it is probably a developmental feature. Unfortunately the formalin in which the specimens are preserved has destroyed most of the otoliths, in some otocysts all of them, so it is impossible to tell whether the number counted by Hartlaub is repeated here.

Color.—In formalin, stomach, gonads, and tentacular bulbs are pale yellowish-brown.

The previous records of the species are from Helgoland and the east coast of Scotland.

Genus TIMA Eschscholtz, 1829.

Up to the present time this genus has not been recorded from the Indo-Pacific; but the *Albatross* collection contains a single very large medusa, which is best referred to *Tima*, though it differs from the excellent specimens of the two Atlantic species, *lucullana* and *formosa*, with which I have compared it, in the extraordinary complexity of the lips, and in having a much shorter peduncle. These differences seem to warrant a new species.

TIMA SAGHALINENSIS, new species.

Station 5028, September 28, 241–0 fathoms (off Saghalin Island); 1 specimen, about 100 mm. in diameter.

Type.—Cat. No. 31055, U.S.N.M.

The peduncle is nearly cylindrical, only slightly narrowed distally, and only about 14 mm. long. But though small, it is perfectly evident, and quite as well marked off from the subumbrella as it is in the other Timas. In both *T. formosa* and *T. lucullana* the peduncle is long, hanging to, or below the opening of the bell.

Marginal organs.—Unfortunately there is not a single tentacle intact, so I was much surprised to find a large number of otocysts preserved. Tentacular knobs were likewise distinguishable, alternating with the otocysts, much as they do in *T. formosa*, and occa-

Digitized by Google

sionally I could make out the scar which marked the location of a tentacle. As to the numbers of the various organs, not much can be said. It is impossible to make any estimate of the tentacles, but the otocysts and bulbs, of which there are about as many of one as of the other, are evidently very numerous, for I counted 16 otocysts over about one-twentieth of the circumference. In this distance there was the scar of only one tentacle; the bulbs could not be counted, but each one that could be seen lay between two otocysts. These observations suggest a total of some 300 otocysts and knobs; that is, about the same number as in large specimens of *T. lucullana* which have 64 or more large tentacles and upward of 300 knobs; in *formosa* 39 is the largest number of tentacles I have counted [Mayer (1910) credits it with 32 only], and there are only about 100 bulbs (96, according to Mayer).

The otocysts of the Pacific specimen are large, and in two of the best preserved ones 8–10 otoliths could be seen, lying in a single series around the periphery of the vesicle, just as they do in *T. formosa* (Mayer, 1910, pl. 41, fig. 3). The gonads begin close to the manubrium, at the distal end of the peduncle, run over that organ and over the subumbrella nearly to the ring canal, being largest in the region of the peduncle and the central part of the subumbrella, and growing smaller toward the margin. Each gonad consists of a single fold or lamella, thrown into a close series of transverse folds. In their present condition the lamellae are more or less split over part of their lengths, so that each seems to be double, but this is clearly accidental.

Manubrium.—The manubrium is short (contracted), the lips much more complex than in either *lucullana* or *formosa*.

Color.—In formalin gonads, manubrium, and lips are pale, but opaque, ochre-yellow.

Family AEQUORIDAE Eschscholtz, 1829.

Genus AEQUOREA Péron and Lesueur, 1809.

I had hoped that the *Albatross* collection, together with the series in the Museum of Comparative Zoology, would afford the basis for a revision of this puzzling genus, but the gaps, both geographic and structural, are too serious to allow this.

The difficulty has been to find any character or combination of characters sufficiently stable to afford a basis for classification, the only two which seem to be precise, so far as we yet know, being the presence or absence of gelatinous subumbral papillae and of excretory papillae. The former has been made by Mayer the distinguishing character of *Zygodactyla*, but gelatinous papillae are not present in the type of *Zygodactyla*, *Z. coerulescens* Brandt, and another

Digitized by Google

Aequorid which has them is *Zygocanna* (of which I have studied specimens from the Philippines), with branched canals. All Aequorids with unbranched canals are referred here to *Aequorea*. One of them, *groenlandica*, has subumbral papillae; and only one, *pensile*, lacks excretory papillae.

Somewhat to my surprise a character which proves to be one of the least variable in *Aequorea* is a trivial one—that is, proportional diameters of stomach and bell, a very small stomach, only about one-fourth or one-fifth as wide as the bell, distinguishing *A. tenuis* and its close ally, *A. floridana*, from all other Aequoreas.

The forms remaining after the elimination of *tenuis* (+ *floridana*), *groenlandica*, and *pensile*, are all closely allied to one another. Vanhöffen (1911) considers the relative number of tentacles and canals sufficiently important to subdivide them, but the collection which I have studied shows that it can not be used as a specific character, because there is an unbroken series from specimens with many more canals than tentacles, to ones with many more tentacles than canals. The only tangible character for this purpose seems to be the shape of the tentacular bulbs, according as they do ("*macrodactylum*") or do not clasp the exumbrella ("*aequorea*"). But the Philippine series of *macrodactylum* shows that the clasps vary from being as pronounced as figured by Maas (1905) to a condition where it is difficult to say whether they are present or not. On the other hand, some of the tentacles in one of the specimens from Naples which I have studied clasp the exumbrella nearly as much as the less pronounced ones in *macrodactylum*, while others do not, but are constricted at the base. Thus no hard and fast line can be drawn separating the extremes. Nevertheless it is usually, if not always, possible to place a given specimen in one group or the other, at least I have never seen one absolutely intermediate, although a considerable number have been examined. Here, as in other instances among medusae, the relationship of the two can be best represented graphically by a dumb-bell shaped figure, not by two isolated circles. And although we do not know whether the groups, or species, have been differentiated phylogenetically, or by physiological or by environmental factors, we can say, from the known records, that members of any given swarm are usually all of one type or of the other, while all recent records of *macrodactylum* are from the Tropics (Pacific, and one Gulf Stream); none from the Mediterranean or colder waters. With our present limited knowledge of the two it is best to retain *macrodactylum* provisionally as a distinct species.

All remaining Aequoreas probably belong to a single species, *A. aequorea*. Most of the Pacific Aequoreas, like most of those from the Adriatic recorded by Claus, and the Naples specimens which I have examined, and those from the Tortugas studied by Mayer

Digitized by Google

(1910), have about as many tentacles as canals, varying to one side or the other to a greater or less degree, besides a large, though variable, number of tentacular rudiments, connected with fully formed tentacles by a series of developmental stages. But forms with three to five times as many tentacles as canals are represented in the Pacific ("*coerulescens*") as well as in the Atlantic ("*albida*"). In the Atlantic the many-tentacled form is known only from cold waters (Labrador, Newfoundland, Norway), but this is not true of the Pacific.

In the present paper the form with many tentacles, and the one with about equal numbers of tentacles and canals, are treated provisionally as varieties of *Aequorea aequorea*.

AEQUOREA AEQUOREA (Forskål).

Medusa aequorea FORSKÅL, 1775, p. 110; 1776, pl. 32.
Medusa patura MODEER, 1791, p. 32.
Aequorea forskalea PÉRON AND LESUEUR, 1809, p. 336.

For synonymy, see Mayer, 1910, p. 325; to which should be added—

Aequorea globosa ESCHSCHOLTZ, 1829, p. 110, pl. 10, fig. 2.—MAAS, 1905, p. 43, pl. 8, figs. 48–50.
Aequorea albida A. AGASSIZ, 1862, p. 359; 1865, p. 110, figs. 160–162.
Aequorea norwegica BROWNE, 1903, p. 19, pl. 5, figs. 1–5.
Mesonema victoria MURBACH and SHEARER, 1902, p. 72; 1903, p. 180, pl. 19, figs. 1–2; pl. 22, fig. 2.
Aequorea floridana MAYER, 1910, p. 330, pl. 43, figs. 6, 7 (*not* L. Agassiz, 1862, p. 361.—A. AGASSIZ, 1865, p. 67, fig. 139).

This species has universally been called *forskalea*, following Péron and Lesueur (1809), but this name was expressly given by them to the *Medusa aequorea* of Forskål (1775), and all modern authors are agreed that the animal in question is the same that Forskål described.

1. var. AEQUOREA.

I thus designate the variety in which there are about as many tentacles as canals, many of the knobs remaining rudimentary; that is, the form which has usually been described as "*A. forskalea.*" There is, as pointed out above, no sharp line between it and the var. "*albida,*" which has several times as many tentacles as canals; but the extremes are so distinct that they are treated separately here for the sake of convenience.

Union Bay, British Columbia, surface; 7 specimens, 36–48 mm. in diameter; in excellent condition.

Friday Harbor, Puget Sound; 10 specimens, 38–72 mm. in diameter; excellent condition.

Digitized by Google

The series affords the following numerical data:

1. UNION BAY.

Diameter.	Diameter of stomach.	Number of canals.	Number of tentacles.	Number of bulbs.	Total number of tentacular organs.
48	25	52	72	53	125
52	about 26	63	71	39	110
45	about 22	53	67	69	146
47	22	47	66	66	132
43	21	54	80	39	119
44	22	59	68	55	123
36	19	39	62	46	108

2. PUGET SOUND.

72	36	83	91	108	199
55	24	74	71	88	159
50	25	93	70	80	159
45	21	59	90	76	166
38	about 20	57	53	73	126

3. SPECIMEN FROM NAPLES.

79	39	78	65	140	218

Thus the numerical proportion between tentacles and canals is variable according as more or fewer bulbs develop into tentacles.

In specimens up to 190 mm. in diameter Torrey found the tentacles more numerous than the radial canals (about 120), and in one 55 mm. in diameter from San Diego there were 90 canals; in the Puget Sound series studied by Murbach and Shearer (1903) there were about as many tentacles as canals (about 100 of each in specimens 70 mm. broad) besides numerous knobs.

The general "habitus" has often been described, and its chief variations have been tabulated by Mayer (1910).

The shape of the tentacular bulbs is important, because of its bearing on the status of *A. macrodactylum*. In most cases they are somewhat triangular, tapering, slightly narrower at their junction with the margin than just below, circular in cross section, and in side view we see that they cover very little, if any, of the exumbrella. On some of the largest tentacles, however, the bulbs are so much thicker that they do cover a considerable amount of the exumbrella, and it would take only a slight increase in this respect to equal the small tentacles in *A. macrodactylum;* but none have distinct clasps. The bulbs of half-grown tentacles are fusiform.

The excretory papillae are very prominent, one associated with every tentacle, and even with the youngest knob, from which it appears that in development knob and papilla are formed at about the same time. After preservation the mouth is wide open in all our specimens; nor does it give any clue to its normal ability to expand,

Digitized by Google

so graphically described by Murbach and Shearer (1903), because the lower gastric wall shows no signs of contraction.

The gonads afford another instance of variability, for in large specimens new canals are interpolated in an entirely irregular way. In the present specimens there is a varying number of young canals, some of which are still blind, while others have reached the ring canal. Preexisting canals, too, can bi- or tri-furcate, though this is less common, and occasionally two canals unite. But there is never as much anastomosis as is seen in large specimens of *A. pensile*. Gonads are formed on the young canals when they reach the margin, and according as more or fewer of the canals are of recent growth large or small gonads preponderate in a given individual. In all of the *Albatross* specimens most of the canals are old; for example, in an individual of 50 mm. with 73 canals there are 67 large gonads, and the remaining 16 canals have none.

2. var. ALBIDA.

Dutch Harbor, May 25, surface; 2 specimens, about 120 and about 165 mm. in diameter; in formalin.

These specimens are in fairly good anatomical condition, but they are much flattened, and the gelatinous substance is very hard, their appearance suggesting that they were first put in alcohol. Under the circumstances nothing can be said about general form further than to note that the subumbrella is smooth.

In the larger specimen there are 227 canals and about 675 tentacles of different ages, old and young roughly alternating. Several small segments of the margin are destroyed, but wherever it is intact, as it is over most of the circumference, the ratio between tentacles and canals is slightly more than 3:1. Thus, over 25 canals I counted 84 tentacles and 3 rudimentary knobs.

In the smaller specimen there are 171 canals and 549 tentacles—that is, a ratio of slightly more than 3:1—and about 10 rudimentary knobs. Specimens from Newfoundland and Grand Manan give the following data: diameter 85 mm., 81 canals, about 380 tentacles, and about 12 knobs (72 tentacles and 3 knobs over 15 canals); diameter 69 mm., 97 canals, about 370 tentacles, and 90 knobs (53 tentacles and 12 knobs over 14 canals); diameter 55 mm., 99 canals, 204 tentacles, and about 75 knobs. The tentacle-bulbs are fusiform, slightly flattened laterally, and narrower at their junction with the margin; they do not clasp the exumbrella. There is an excretory papilla at the base of each tentacle, though it might easily be overlooked in the Bering Sea specimens owing to distortion.

Stomach and mouth.—In the larger specimen the stomach is about 85 or 90 mm. in diameter; in the smaller about 63 mm.—that is, in each it is slightly more than half as broad as the bell as a whole; and in each the mouth is nearly closed by long pointed lips, which are

Digitized by Google

much less numerous than the canals; for example, in the larger specimen there were only 10 lips corresponding to 37 canals.

Gonads.—Each canal bears a well developed gonad.

Color.—No pigment is evident, but it may have been destroyed by preservation.

AEQUOREA PENSILE (Modeer) Haeckel.

Medusa pensile MODEER, 1791, p. 32.

(For synonymy, see Mayer, 1910, p. 333.)

Station 4961, 33–0 fathoms; 9 rather fragmentary specimens, 25–45 mm. in diameter.

The greater part of the margin is torn off in all of the specimens, so that it is impossible to count the tentacles; but on the portions which are intact there are 10–12 canals between every two tentacles, and the tentacular bases are broad, extending more or less along the bell margin. In these respects, as well as in having a large number of canals, a very thick lenticular disk, and in the absence of excretory papillae, which, of course, I specially sought, the specimens agree with better preserved examples of *pensile* from the Philippines.

Order TRACHOMEDUSAE.

Family PETASIDAE Haeckel, 1879. (Browne, 1904; Bigelow, 1909*a*.)

Genus OLINDIOIDES Goto, 1903.

OLINDIOIDES FORMOSA Goto.

Olindioides formosa GOTO, 1903, p. 3, pl. 1, figs. 1–9; pl. 2, figs. 14–16; pl. 3, figs. 17–20.—MAAS, 1909, p. 29.—MAYER, 1910, p. 358.

Station 4883, surface ?; 1 specimen, 50 mm. in diameter.

Station 4884, 53–0 fathoms; 11 specimens, 32–110 mm. in diameter.

Station 4885, 53–0 fathoms; 2 specimens, 45 and 125 mm. in diameter.

These few specimens agree very well with the excellent accounts of much larger series given by Goto and by Maas.

Family PTYCHOGASTRIDAE Mayer, 1910.

Genus PTYCHOGASTRIA Allman, 1878.

PTYCHOGASTRIA POLARIS Allman.

Ptychogastria polaris ALLMAN, 1878, p. 290.—BROWNE, 1903, p. 24, pl. 4, figs. 1, 2; pl. 5, figs. 6, 8.—BIGELOW, 1909*c*, p. 310.

Pectyllis arctica HAECKEL, 1879, p. 266; 1881, p. 11, pls. 3, 4.

(For full synonymy, see Mayer, 1910, p. 372.)

Station 4781 (Bering Sea), 30–0 fathoms; 7 specimens, 10–18 mm. in diameter; much contracted.

Digitized by Google

Station 3325 (Bering Sea), 109–0 fathoms, August, 1890; 1 specimen.

Unfortunately all of the specimens are in poor condition, the exumbrella being much damaged and the margin so nearly destroyed that there is not a single tentacle or sense-club intact. But specific identification rests on a comparison with a better series from Labrador (Bigelow, 1909*c*, p. 310). In two examples the subumbrella, gonads, and manubrium are in good condition, and show clearly that Browne (1903) was entirely correct in his description of the gonads as situated exclusively on the walls of the manubrium entirely independent of the radial canals. In both the specimens in question the gonads are discontinuous along the narrow line of attachment of the mesenteries to the manubrium just as they were in my Labrador specimens and those described by Browne, as well as in the interradii, so that there are 16 separate adradial sexual masses.

In one specimen the mouth is protruded in a tube of considerable length; in the other it is contracted; in both the lip is simple and circular.

Ptychogastria polaris is known from the coast of Nova Scotia, Labrador, Greenland, Spitzbergen, Norway, the north coast of Russia, and Barents Sea.

Family TRACHYNEMIDAE Gegenbaur, 1856.

Genus AGLAURA Péron and Lesueur, 1809.

AGLAURA HEMISTOMA Péron and Lesueur.

Aglaura hemistoma PÉRON AND LESUEUR, 1809, p. 351.

(For synonymy, see Bigelow, 1909*a*, p. 119, and Mayer, 1910, p. 398.)

Station 4896, surface; 10 specimens, 1.5–4 mm. high.

Sado Island, Sea of Japan, surface; 14 specimens, 1.5–3 mm. high.

Station 4955, surface; 2 specimens.

The specimens show variation in general form, some being higher and narrower, others lower and broader; but all are circular in cross section, and so were the Japanese specimens studied by Maas (1909). The smallest, 1.5 mm. high, have no gonads, but these organs are visible in some 2.5 mm. high, and are well developed in the larger specimens.

Genus AGLANTHA Haeckel, 1879.

The collection contains a considerable series of *Aglantha*, and though most of the specimens are in poor condition they show that they belong to a large form with more than four [probably normally eight] otocysts, and that the gonads first appear in specimens 8–10 mm. high. They thus agree with the larger of the two size-varieties of *Aglantha* which I recorded from Labrador (1909*c*), and these same characters distinguish a series collected by the *Michael Sars* in the

Digitized by Google

Faroe Channel in August, 1910, between 1,000 and 500 meters, for which I have to thank Doctor Broch.

In describing the Labrador collection I used the name *rosea*, following Browne (1903), Maas (1906*b*), and Hartlaub (1909*a*), who separate *rosea* with eight otocysts from *digitale* with four. But Mayer (1910) has found that there is no discontinuity in this character, because specimens may normally have 3, 4, 5, 6, or 8, and all the large specimens studied by me have 6–8 otocysts, if those organs are visible at all, which is very often not the case. The otocysts are so easily detached in *Aglantha* that the identification of many of the collections which have been recorded as *digitale* or as *rosea* rests on no more certain ground than size or geographic location; but there is certainly no correlation between size and number of otocysts, for I have seen specimens from 29–30 mm. high, as well as some with large gonads of only 10–15 mm. with eight of these organs (1909*c*). For these reasons it is probable that Mayer (1910) was justified in uniting the two species, and I therefore follow him, referring the present collection to *digitale*. But revision, which the genus is in urgent need of, will probably show that the latter has several size-varieties.

AGLANTHA DIGITALE (Fabricius) Haeckel.

Medusa digitale FABRICIUS, 1780, p. 366.

(For synonymy, see Mayer, 1910, p. 402.)

The species was taken at the following stations: 4758, 4759, 4760, Dutch Harbor, 4762, 4763, 4766, 4767, 4775, 4783, 4785, 4793, 4797, 4800, 4805, 4806, 4810, 4818, 4819, 4820, 4830, 4831, 4847, 4866, 5030, both on the surface and in hauls with open nets from 300 fathoms. The series consists of about 300 specimens ranging in height from 8–25 mm.

The few specimens which were in good enough condition to show the otocysts afforded the following data:

Locality.	Height.	Tentacles.	Otocysts.	Gonads.
	mm.			
Dutch Harbor	8	68	8	Medium.
Do.	9	76	8	Do.
Do.	9	86	7	Do.
4810	10	87	5+	Small.
Dutch Harbor	11	89	7	Large.
4673	15	153	6	Do.
4820	17	124	8	Do.

In all of these specimens, as in the Labrador series, the course of the radial canals is direct, instead of in an S curve, as it was in the specimens from the intermediate waters of the eastern tropical Pacific (var. *intermedia*, 1909*a*). There seems to be normally one otocyst to the octant; but some otocysts may lack them in specimens so good that we can not assume that they were present but are lost, and this same phenomenon is recorded by Mayer.

Digitized by Google

Genus RHOPALONEMA Gegenbaur, 1856.

RHOPALONEMA VELATUM Gegenbaur.

Rhopalonema velatum GEGENBAUR, 1856, p. 251, pl. 9, pp. 1–5.

(For synonymy, see Bigelow, 1909*a*, p. 129, and Mayer, 1910, p. 378.)

Station 4897, 150–0 fathoms; 3 specimens, about 7 mm. in diameter.
Station 4920, 300–0 fathoms; 4 specimens, 6–9 mm. in diameter.
Station 4978, surface; 6 specimens, 8–10 mm. in diameter.
Station 5064, 300–0 fathoms; 2 specimens, fragmentary.

The specimens are so battered that it is impossible to add anything to the earlier accounts of the species further than that all show a well-marked apical thickening or top knot.

Genus PANTACHOGON Maas, 1893.

Homoeonema VANHÖFFEN (1902*b*); Mayer (1910, part).
Isonema MAAS (1906*a*).
Not *Homoeonema* MAAS (1893).—BROWNE (1903).

Trachynemidae with numerous tentacles, in one row, and all alike; without peduncle.

The genus *Isonema* was instituted by Maas for two species, *amplum* Vanhöffen and *macrogaster* Vanhöffen, in which the gonads are spherical and lie close to the manubrium. But studies of a series of *P. haeckeli* have convinced me that the precise location of these organs on the canals is better used as a specific character. The genus, as here amplified, includes six species, *Homoeonema militare* Maas, *Homoeonema amplum* Vanhöffen, *Homoeonema macrogaster* Vanhöffen, *Pantachogon rubrum* Vanhöffen, *Pantachogon scotti* Browne, and *Pantachogon haeckeli* Maas, the last being the type. *Homoeonema platygonon* Maas is grouped with the preceding by Mayer (1910), but Maas (1906*b*) has pointed out that its type specimen belongs to a different family, the Halicreasidae.

The position of the gonads separates the members of *Pantachogon* into three groups, *amplum* and *macrogaster* in which they are close to the manubrium; *militare* in which they are limited to the distal half of the canals; and *haeckeli*, *scotti*, and *rubrum*, in which they occupy nearly the whole length of the canals. It is doubtful whether the first two are separable from each other, and the same is true of *haeckeli* and *rubrum*, which can be told apart only by the brilliant red color of the latter. *Scotti* is distinguished from the last two by its more numerous tentacles (about 120 instead of 64).

PANTACHOGON HAECKELI Maas.

Plate 3, figs. 4–8.

Pantachogon haeckeli MAAS, 1893, p. 17, pl. 1, fig. 2; 1904, p. 29.—MAYER, 1910, p. 389, fig. 239.

Station 4758, 300–0 fathoms; 7 specimens.
Station 4760, 300 fathoms; 7 specimens.

Digitized by Google

Station 4763, 300 fathoms; 18 specimens.
Station 4764, 1130–0 fathoms; 2 specimens.
Station 4766, 300–0 fathoms; 10 specimens.
Station 4767, 300–0 fathoms; 12 specimens.
Station 4774, 557–0 fathoms; 1 specimen.
Station 4775, 200–0 fathoms; 24 specimens; excellent condition.
Station 4800, 300–0 fathoms; 14 specimens.
Station 5030, 1800–0 fathoms; 4 specimens; fragmentary.

Most of the specimens are in good condition, except that the tentacles are broken short off. The series ranges in height from 5–19 mm. Up to the present time only two specimens of this species have been recorded, one young (Maas, 1893, 8 mm.), the other fragmentary (Maas, 1904*b*).

In general outline the specimens are thimble-shaped, with deep bell cavity, and thin gelatinous substance (pl. 3, fig. 4); most of them are about as broad as high, but several are proportionately broader, though in good condition. Probably the differences in this respect between different specimens are due to varying states of contraction.

The exumbrella is marked by a regular series of meridional furrows, running from apex to margin, thirty-two in every large specimen in which I could count them; the subumbrella is extremely muscular.

Manubrium.—The manubrium is flask-shaped, sessile, without a trace of peduncle, the mouth surrounded by four pointed lips (pl. 3, fig. 8).

In the original specimen of *haeckeli* the eight gonads extended the whole length of the radial canals, forming several irregular thickenings on each. Very much the same condition is to be seen also in our small specimens, 6–8 mm. high (pl. 3, fig. 5), in which each canal bears from 2–4 sexual swellings, connected or not according to their age. But the sexual centers do not remain independent, for as growth progresses, sex-tissue is developed along almost the entire length of each canal, connecting them in a continuous ridge (pl. 3, fig. 6), which finally takes on a wavy form (pl. 3, fig. 7). The development of the gonads is very irregular, not only in different specimens, but often in the different canals of a given specimen, and the largest gonads were found in a specimen only 14 mm. high. Another feature adding to their irregularity is that in all the large specimens the sexual products had been shed over the distal end of each gonad, as is made noticeable by a difference in color, the distal part being white instead of brownish-yellow.

Marginal organs.—In every specimen, large and small, which was in good enough condition to show the stumps of the tentacles, there are 64, that is, 8 perradials and 7 subradials in each octant; and the same is true in *P. rubrum*. Between the bases of the tentacles the margin is thickened, forming rounded prominences crowded with

Digitized by Google

nematocysts, and there are 64 otocyst-clubs alternating with the tentacles, as in *P. rubrum*. Structurally the clubs agree with Vanhöffen's (1902*b*) figure of clubs of the latter species.

Color.—The specimens are colorless, the subumbrella highly iridescent. One specimen appeared, at first sight, to have a reddish tinge, but on examination it proved that the color was confined to the exumbrella surface, and was evidently an accidental stain. In *P. rubrum* subumbrella and manubrium are rosy red.

Genus COLOBONEMA Vanhöffen, 1902.

Colobonema MAAS (1905).—BROWNE (1906).—BIGELOW (1909*a*).
Homoeonema MAYER (1910) part.

The one species of *Colobonema* yet known is characterized by the order of development of its tentacles, of which the 8 perradial, the 16 adradial, and finally the 8 interradial appear successively, 32 being the final number in every specimen which has yet been examined. Though it is not yet certain that this type of succession is peculiar to *Colobonema*, it is certainly unusual, and there is no evidence that it occurs elsewhere.

Maas (1905) and Mayer (1910) use the name *typicum*, believing that *sericeum* Vanhöffen is identical with the form from the Gulf of California earlier described by the former as *Homoeonema typicum*, and for the sake of uniformity the same course is followed here.

C. typicum Vanhöffen is now known to be a mesoplanktonic form of very wide distribution (Bay of Biscay, west coast of Africa, Malaysian region, Philippines, eastern tropical Pacific, and northwestern Pacific).

COLOBONEMA TYPICUM (Maas).

Homoeonema typicum MAAS, 1897, p. 22, pl. 3, figs. 1–3.

(For synonymy, see Mayer, 1910, p. 385.)

Station 4905, 369–0 fathoms; 1 specimen, about 32 mm. in diameter.

Station 4909, 300–0 fathoms; 2 specimens, 40 and 30 mm. in diameter.

Station 4917, 361–0 fathoms; 1 specimen, about 35 mm. in diameter.

Station 4920, 440–0 fathoms; 1 specimen, 28 mm. in diameter.

Station 5066, 211–0 fathoms; 1 specimen, 32 mm. in diameter.

The material is not good enough to add much to the earlier accounts, but it is interesting as further evidence of the invariable number 32, of tentacles, of which the interradial in each octant is always the smallest; and because one specimen shows the gonads, the two which are intact being nearly cylindrical, narrow and smooth, and extending from close to the apex nearly to the margin, much the condition observed by Maas (1905). No otocysts were preserved, but one is intact in a specimen from the Philippines. The manubrium usually hangs to about the mid level of the bell, but may be contracted.

Digitized by Google

Genus CROSSOTA Vanhöffen, 1902.

This interesting genus was founded by Vanhöffen for a Trachomedusa, conspicuous for its dense pigmentation, with 8 canals, 8 sausage-shaped gonads hanging from the canals at the top of the bell, a short, broad manubrium, and several rows of tentacles of different ages. It has since been recorded by me (1909*a*) from the eastern Pacific expedition of the Fisheries steamer *Albatross*. The original describer and Maas (1906*b*) grouped *Crossota* with *Ptychogastria* because of the arrangement of the tentacles, and I (1909*a*) followed the same course, though pointing out that it lacks the mesenteries of *Ptychogastria*, while the tentacles are not radially grouped. But my own studies on *Ptychogastria* (1909*c*) have convinced me that *Crossota* has no relationship with it, because the gonads in *Ptychogastria* are developed in the walls of the manubrium, whereas in *Crossota* they are borne on the radial canals. Mayer (1910) groups the genus with *Halicreas* and *Botrynema;* but in *Crossota* the manubrium is highly organized, with distinct digestive and labial portions, while the tentacles, as the present series shows, are of the usual Trachynemid type, instead of having a distal spine such as is characteristic of *Halicreas*. In the original species of the genus, *brunnea*, the tentacles are in several rows, but in a new species in the collection this arrangement is less developed, and in young stages (p. 49) the tentacles are in a single row.

With these facts in view, I have no doubt that the phylogenetic relationship of *Crossota* is with the Trachynemidae, and especially with such genera as *Aglantha* and *Aglaura*, which it resembles in its sense organs, its gonads, and its manubrium, and from which it differs only in the arrangement of tentacles in the adult.

Two species of *Crossota* were described by Vanhöffen, *brunnea*, the type, and *norvegica;* the only difference between the two being that the latter was of a brighter red color than *brunnea* and that it had gonads, though smaller; distinctions so slight that both Mayer (1910) and I (1909*a*) have classed *norvegica* as a synonym of *brunnea*. But the present collection shows that I went too far in uniting them unequivocally, for it contains a large and excellently preserved series from Bering Sea, all of the "*norvegica*" type; and though the differences between them and *brunnea* are slight, the characters separating them from the latter are exactly those to which Vanhöffen called attention; that is, rather brighter color and the presence of gonads in smaller specimens, to which I may add fewer tentacles at maturity. Now these differences are so slight that they may be evidence of nothing more important than swarm variation such as is so prevalent in *Aequorea*. But, on the other hand, the appearance of typical *norvegica* in cold waters far removed from its type locality seems rather to suggest that it may be a stable form. Before we can answer the question defi-

Digitized by Google

nitely one way or the other many more Crossotas from various localities must be studied with an eye to their variation. And as *norvegica* is very much closer to *brunnea* than is either of the two new species in the collection, the wisest course is to class it for the present as a variety of the former.

The two new species agree with *brunnea* in their general form, in the structure of the gonads, in the arrangement of the tentacles in several rows, and one of them at least in the structure of the sensory clubs; but the gonads in both are borne at or below the mid-level of the bell in the adult instead of near the apex, while one has a gelatinous peduncle. The presence of a peduncle is so important a character that it might be made the basis of a new genus. But it seems to me that to do so would tend to obscure the obvious affinity of the medusa in question to the other species of *Crossota*, and that it is therefore wiser to refer it to that genus. Pigmentation, too, helps to separate one of them in which it is restricted to the manubrium.

The four members of *Crossota* may be summarized as follows:

A. No peduncle.
1. Gonads hanging from canals close to apex. Subumbrella pigmented.
a. Gonads appear first when bell is about 16 mm. in diameter.....*brunnea*.
b. Gonads visible in specimens only 80 mm. in diameter
brunnea, var. *norvegica*.
2. Gonads hanging from radial canals at about the mid-level of bell. Manubrium heavily pigmented, but subumbrella unpigmented.....*alba*, new species.
B. Manubrium situated on a gelatinous peduncle; gonads at or below mid-level of bell; subumbrella pigmented .....*pedunculata*, new species.

CROSSOTA BRUNNEA Vanhöffen, var. NORVEGICA Vanhöffen.

Crossota norvegica VANHÖFFEN, 1902*b*, p. 75.—MAYER, 1910, p. 396, fig. 249.
Crossota brunnea (part) BIGELOW, 1909*a*, p. 135.

Station 4758, 300–0 fathoms; 5 good specimens.
Station 4759, 300–0 fathoms; 7 fragmentary specimens.
Station 4760, 300–0 fathoms; 12 specimens.
Station 4763, 300–0 fathoms; 23 specimens.
Station 4764, 1,130–0 fathoms; 3 specimens.
Station 4766, 300–0 fathoms; 38 specimens.
Station 4767, 300–0 fathoms; 15 specimens.
Station 4793, 300–0 fathoms; 33 specimens.
Station 4797, 300–0 fathoms; 1 specimen.
Station 4800, 300–0 fathoms; 18 specimens.

The specimens range from 4 mm. to 22 mm. in diameter, and as a whole they are in a fair condition, while one, 18 mm. in diameter, is more nearly perfect than any example of *Crossota* previously recorded. They are thimble-shaped, with a deep bell and with the exumbrella marked by a large number of shallow meridional furrows just as in Vanhöffen's material, and I can definitely announce that the adult *Crossota* has sense clubs. Vanhöffen has already described them in a

Digitized by Google

young stage about 7 mm. in diameter; but they could not be found in the adults collected by the *Valdivia* nor in the eastern Pacific series. Several of the tentacles of the best specimen, too, are intact, though most of them are broken short off, as has been the invariable rule in all Crossotas yet described. The sense clubs, which are very small and difficult to find among the closely crowded tentacles, have a single terminal concretion; that is, they are of the usual Trachynemid type. I could not count them.

Tentacles.—In the best specimen there are about 43 tentacles to the octant, closely crowded together, in three or four irregular rows, with the oldest farthest from the margin, as described by Vanhöffen. It is impossible to distinguish the members of the successive series of development, but the ones most recently formed lie closest to the margin, and there are some so young that they are still mere cirri. In Vanhöffen's large specimens of *brunnea* (32 mm. in diameter), the tentacles were more numerous, up to 84 to the octant, and, of course, an equally large number may be attained in *norvegica*, for we have no right to assume that any of the specimens have reached their final dimensions. Structurally the few tentacles which remain intact are of the usual Trachynemid type, being solid, with a core consisting of chordate cells, and with the pigment confined to the entoderm. In a specimen 4 mm. in diameter the tentacles, though of different sizes, lie in a single row, 12, 13, 11, in three successive octants. The smallest specimen with gonads is 11 mm. in diameter; in specimens 15–20 mm. they are almost as long as the manubrium. In the eastern Pacific series of *brunnea* the smallest specimen with gonads is 17 mm. in diameter; and even in this one they are only minute swellings on the radial canals.

Color.—The entire subumbrella, manubrium, and gonads are so heavily pigmented with chocolate-brown as to be practically opaque. The tentacles, too, are reddish-brown, the tint being rather brighter than in the eastern Pacific specimens of *brunnea*, or in Vanhöffen's (1902*b*) figure of the latter. The manubrium agrees with Vanhöffen's account, being sessile and much contracted in all the specimens.

One of the interesting things which the series shows is that the pigmentation is as general and as dense in specimens 4 and 5 mm. in diameter as it is in larger ones.

CROSSOTA ALBA, new species.

Plate 3, figs. 9–12.

Type.—Cat. No. 31056, U. S. N. M.

Station 4920, 300–0 fathoms; 1 specimen, type.

Station 5050, 300–0 fathoms; 1 specimen.

The specimens are both about 22 mm. in diameter by 18 mm. high, with deep bell cavity and comparatively thin gelatinous substance.

Digitized by Google

While neither is perfect, the type having lost the musculature over most of the subumbrella, the two together give a good idea of the species. The exumbrella is furrowed by a large number of shallow meridional grooves, just as it is in *C. brunnea;* indeed, this seemingly trivial feature is characteristic of the whole genus. The entire subumbrella, as shown by the specimen from station 5050, is clothed with a powerful musculature of circular fibers, and the rather broad velum is also very muscular.

The manubrium in the type is about 9 mm. long by 1.5 mm. broad, cylindrical, sessile on the subumbrella (that is, without peduncle), and the mouth is surrounded by four pointed lips (pl. 3, fig. 9). Digestive and labial portions are sharply defined by the fact that the pigmentation is limited to the former. In the other specimen the manubrium is much contracted (pl. 3, fig. 11).

The eight sausage-shaped gonads, which hang free in the bell cavity, being attached only at one end, are situated on the radial canals only about one-third of the meridional distance above the margin (pl. 3, figs. 9, 11) and fortunately they are so well preserved that there is no doubt about their form and location.

Marginal organs.—Most of the tentacles are broken short off in both specimens, but their stumps are well preserved in both, and they are especially clear in the type, which is not contracted at all. The tentacles are arranged in three irregular rows (pl. 3, fig. 10) as in *C. brunnea,* the oldest being farthest from, the youngest closest to, the margin, and each tentacle root, of course, connects with the circular canal. In the type there are large stumps opposite five of the radial canals, but none to correspond with the other three. The number of tentacles per octant is 23, 24, 24, 17, 22, 25, 20, 24, a total of 179, that is, only about one-third as many as in *C. brunnea* of about the same size. The few tentacles which are not broken off are soft and so much damaged that there is nothing to say about them except that they evidently do not have any distal spine-like portion.

The sense clubs (pl. 3, fig. 12) are small, and each contains a single terminal concretion. They were seen in both specimens, but evidently most of them had been lost, so all I can say as to their number is that they were apparently not more than half as numerous as the tentacles.

Color.—The digestive portion of the manubrium is chocolate-brown, so densely pigmented that it is almost black. So far as can be seen from surface views (I did not wish to section either of the specimens) the pigmentation is purely entodermic. The lips are not pigmented. Except for the manubrium, the animal is colorless, though the subumbral musculature is highly iridescent.

Digitized by Google

CROSSOTA PEDUNCULATA, new species.

Plate 3, fig. 13.

Fisheries steamer *Albatross* station 3066, June 13, 1889, 46° 26′ N. 124° 26′ W. (just north of the mouth of the Columbia River), 50–0 fathoms; 4 specimens, respectively 14, 19, 24, and 25 mm. in diameter.

Type.—Cat. No. 31057, U. S. N. M.

These specimens, from the collection of the United States National Museum, had been in alcohol for over 20 years when they came into my hands, and they are not in good condition. But fortunately they show their more important anatomical features clearly.

In general form, and in the extent of their pigmentation, they resemble *C. brunnea* so closely that I had no doubt I was dealing with that species until I observed the location of the gonads and the peduncle on which the manubrium is borne. The exumbrella, as in *brunnea*, is ribbed with numerous fine meridional furrows, while both subumbrella and velum are very muscular.

Manubrium.—In the two specimens in which it is intact the manubrium is flask-shaped, situated at the end of a short cylindrical neck. On dissection it proved that the neck is a solid gelatinous peduncle, though it is not readily identifiable as such from a surface view, because it, like the rest of the subumbrella, is densely pigmented. On sectioning the digestive apparatus lengthwise it is evident that the peduncle, about 5 mm. long, is cylindrical, and the eight radial canals can be followed lengthwise over it, just as in *Aglantha*. The manubrium itself is much contracted, but, so far as can be seen, it resembles the corresponding organ in *C. brunnea*.

Gonads.—The gonads are sausage-shaped, attached by the upper end only, and hanging free in the bell cavity, as in other Crossotas. In the smallest specimen (14 mm.) they are attached to the canals about one-third of the meridional distance below the apex; in the 19 mm. specimen they are at about the mid-level of the subumbrella (pl. 3, fig. 13); and in the 25 mm. specimen they are about one-third of the meridional distance above the margin. Apparently, then, the gonads become progressively lower and lower with the growth of the bell.

Tentacles.—The tentacles are very closely crowded together, in three or four irregular rows, the oldest and largest being farthest from the margin, just as in *C. brunnea*. In the smallest specimen there are about 75 to the octant; in the 19 mm. one, upward of 80. In the largest they are too much damaged to count. In all of the specimens there are a few very young ones, on the margin. No sense-clubs could be detected.

Color.—The color is not very well preserved, but it apparently was of much the same reddish-brown as in *C. brunnea*, and the

Digitized by Google

pigmentation covered the entire subumbrella, though now it is intact over occasional patches only.

Family HALICREASIDAE Fewkes, 1886.

Family HALICREIDAE Vanhöffen, 1902*b*.

HALICREAS PAPILLOSUM Vanhöffen.

? *Halicreas minimum* Fewkes, 1882*b*, p. 306; 1886, p. 953, pl. 8.
Halicreas papillosum Vanhöffen, 1902*b*, p. 68, pl. 9, figs. 7, 8; pl. 11, fig. 30.—Maas, 1905, p. 57, pl. 10, fig. 70; pl. 11, fig. 71.—Bigelow, 1909*a*, p. 138, pl. 3, fig. 3; pl. 34, figs. 1–3, 5, 8, 10, 11.—Mayer, 1910, p. 391.
Halicreas papillosum, var. *antarcticum* Browne, 1908, p. 237.

Station 4774, depth ?; 1 specimen, 25 mm. in diameter; fragmentary.

Station 4780, 1046–0 fathoms; 3 specimens, 28–30 mm. in diameter; fragmentary.

Station 4797, 682–0 fathoms; 1 specimen, 30 mm. in diameter; fragmentary.

Station 4800, 300–0 fathoms; 1 specimen, 15 mm. in diameter; fragmentary.

Station 5064, 300–0 fathoms; 2 specimens, 35 mm. in diameter; fragmentary.

Although the specimens are all more or less fragmentary, they are interesting as corroborating my earlier account of the tentacles, several of which clearly show the soft proximal and stiff spine-like distal portion (1909*a*), and especially since they show that the characters on which Browne (1908) based his var. *antarcticum*—that is, presence of tubercles on the central projection of the exumbrella—is merely an individual variation, for the projection is smooth in two specimens, tuberculous in a third.

Genus BOTRYNEMA Browne, 1908.

Alloionema Hartlaub, 1909.

This genus, in which the tentacles are in groups, is so far known from a single specimen from the Antarctic, the type of *B. brucei* Browne (1908); and from 5 described almost simultaneously by Hartlaub (1909*b*) from the Arctic Ocean as *Alloionema ellinorae*.

Four specimens in the *Albatross* collection likewise belong to *Botrynema*, and are indistinguishable from *ellinorae*. The latter and *brucei* are closely allied to each other, the only apparent differences being that in *brucei* the margin is cleft into lobes and that the perradial tentacles lie in exumbral grooves. But until more specimens of the Antarctic *brucei* are studied, it is impossible to tell whether these slight differences are significant, or whether they are

Digitized by Google

merely evidence of contraction or of individual variation. In the meantime both species may be retained provisionally.

Plate 4, figs. 1–4.

BOTRYNEMA ELLINORAE (Hartlaub).

Station 4760, 300–0 fathoms; 3 specimens, 10–13 mm. in diameter.
Station 4763, 300–0 fathoms; 1 specimen, 11 mm. in diameter.
Station 4764, 1130–0 fathoms; 1 specimen, 8 mm. in diameter.

The specimens are more or less fragmentary except one, which is in fairly good condition except that most of the tentacles are broken short off.

A good account of this species, with excellent figures, has been given by Hartlaub.

Our best specimen (pl. 4, fig. 1) is 13 mm. in diameter by about 9 mm. high, the bell cavity moderately deep, the gelatinous substance thin at the margins, but thickened to form a rounded prominence or knob at the apex; in *brucei*, likewise, there is a gelatinous knob. Apparently the subumbrella is not especially muscular; but the velum, which is so broad that it fills the entire opening of the bell in the preserved state, is provided with an unusually well developed series of circular fibers.

The eight radial canals are broad and flat, as in other Halicreasidae, and the corresponding gonad is represented on each one by a broader region near the junction with the manubrium. Apparently the specimens are all immature, for the walls of the canals in the sexual regions are but little thickened as yet.

The manubrium is broad, shallow, and of the same general appearance as in other Halicreasidae; the mouth, wide open at present, is surrounded by a simple, unfolded, circular lip.

Marginal organs.—The margin is not lobed as it is in *brucei*, but is smooth, just as Hartlaub found it. There are 8 single perradial tentacles and 16 adradial tentacle groups (pl. 4, fig. 2), with from 7–11 tentacles in each group, and tentacles of different ages, as identified by the length of their stumps, being arranged in a continuous series, the oldest at one end of the group, the youngest at the other. In the groups of tentacles flanking four alternate radial canals, the oldest tentacles are next to the perradius; in the other four pairs of groups the youngest (shortest) tentacle stumps are nearest the perradius. Thus, following around the margin, the two groups in any octant show the one, those in the next octant the other arrangement. And this same arrangement was traced by Hartlaub. In *brucei* the longest basal ends are next the perradius in the group figured by Browne (1908), "but in some of the other groups the shortest basal end occupies this position" (Browne, 1908, p. 240). It was

Alloionema ellinorae HARTLAUB, 1909*a*, p. 8, pl. 76, figs. 3, 4, 6.

Digitized by Google

not clear, however, whether there was a regular alternation in this respect, such as is so evident in *ellinorae*. All of the tentacles are broken off.

Sensory clubs.—The sense clubs closely resemble those of *Halicreas*. They, like the tentacles, are grouped, lying in the perradial regions in the space between the two tentacle groups which flank each radial canal, three in each group (Hartlaub shows four). Each club consists of an ectodermic sheath, and a clear entodermic core (pl. 4, fig. 4), but the boundaries and nuclei of the entodermic cells which were visible in the clubs of *Halicreas* (1909*a*, pl. 33, fig. 8) could not be made out here, and none of them now contain otoliths.

Color.—In formalin the manubrium and canals are pale reddish-brown.

Family GERYONIDAE Eschscholtz, 1829.

Genus LIRIOPE Lesson, 1843.

The "species" of *Liriope*, like those of most other oceanic medusae common enough to find their way often into literature, have long been a fertile field for discussion. Various characters have been used as the basis for specific separation, but as a historical survey would be outside the field of the present paper, it will suffice to say that the only one which has stood the test of time is the shape of the gonads; and even this one must be used with due regard to the changes in form assumed by these organs during their growth.

All the Liriopes in the present collection belong to the type with triangular gonads which I have called *tetraphylla*, but for which Maas (1909) uses the name *rosacea* (he applies *tetraphylla* to a form with rounded or oval gonads close to the ring canal, which, as he points out, is the same as the eastern Pacific form with similar features, which I left unnamed).

In the eastern Pacific collection I found a growth series connecting specimens with triangular gonads with the large specimens in which the gonads are pentagonal (*compacta*, Maas), and as there is a continuous series of stages in growth from the triangular to the pentagonal form, correlated with a general increase in bodily size, it is fairly demonstrated that the latter is an older stage of the former. Maas, too, in his most recent communication on the Indo-Pacific Liriopes (1909), no longer distinguishes sharply between the two, if I read him aright.

The *Liriope* with triangular gonads is recorded from the Atlantic by Vanhöffen, Maas, and Mayer; and I myself have studied numerous specimens of this type from the West Indies, so it is evidently at home in the warm waters of all three great oceans, though, according to Maas, it is not yet known from the Mediterranean. As Vanhöffen pointed out (1902*b*), this triangular-gonad form merges into

Digitized by Google

the "heart-shaped," a fact which I have been able to corroborate on the eastern Pacific series. Therefore all Liriopes with triangular or heart-shaped gonads, which may finally become pentagonal, are best united in one species. Hartlaub (1909*b*), it is true, recognizes a second species with triangular gonads, under the name *L. haeckeli* Götte, but neither of the characters by which he characterizes it, i. e., long peduncle, and gonads close to the circular canal, seem to deserve the importance he gives them, because the first is subject to great individual variation (at least in preserved series), and the second is probably a growth character.

My use of the name *tetraphylla*, instead of *rosacea*, for the species with angular gonads, is warranted, I believe, by the fact that the figure of the former, the oldest *Liriope* (Chamisso and Eysenhardt (1821, pl. 27, fig. 2) has distinctly triangular gonads, the outline being fully as pronounced as it is in the Eschscholtz figure of *rosacea* (1829, pl. 11, fig. 2). It is therefore incorrect to use *tetraphylla* for a *Liriope*, the distinguishing character of which is that its gonads are not triangular.

This leaves the Indo-Pacific form with oval gonads, which both Maas (1905) and I (1909*a*) have studied, without a name; and I am content to let it remain so until some student can determine its relationship to the numerous Atlantic "species" of similar character, with some of which it is undoubtedly identical.

LIRIOPE TETRAPHYLLA (Chamisso and Eysenhardt).

Geryonia tetraphylla CHAMISSO and EYSENHARDT, 1821, p. 357, pl. 27, fig. 2.

(For synonymy, see Bigelow, 1909*a*, p. 112, with the exception that *L. tetraphylla* Maas was wrongly included, as pointed out above.)

Station 4827, surface; 19 specimens, 2–7 mm. in diameter.
Station 4864, surface; 4 specimens, 2–7 mm. in diameter.
Station 4889, surface; 15 specimens, 4–10 mm. in diameter.
Station 4920, 300–0 fathoms; 5 specimens, 8–15 mm. in diameter.
Station 4927, surface; 7 specimens, 6–12 mm. in diameter.
Station 4955, surface; about 20 specimens.
Station 4978, surface; 9 specimens.
Station 5081, surface; 2 specimens, 13 and 16 mm. in diameter.

The series, which as a whole is in good condition, is of interest as illustrating the variability of the species and the impossibility of drawing any exact parallel between gonad-form and general size. Among the larger ones both triangular gonads and pentagonal ones, in contact with one another and consequently truncated, are to be seen. One specimen of 12 mm. has three pentagonal, one triangular. All of the specimens have gonads, as might be expected, for these organs appear when a diameter of 3–4 mm. is reached (Maas, 1909); and they

Digitized by Google

are angular in all, except a few of the smallest which are badly crumpled. This, too, was to be expected, because though they are oval when they first appear, both Maas (1909) and I (1909*a*) have found that they are already triangular in specimens of 5–6 mm.

Genus GERYONIA Péron and Lesueur, 1809.

GERYONIA PROBOSCIDALIS (Forskål) Eschscholtz.

Medusa proboscidalis FORSKÅL, 1775, pl. 36, fig. 1, 1776, p. 108.

(For synonymy, see Bigelow, 1909*a*, p. 116, and Mayer, 1910, p. 425. To the latter add *Geryones elephas* Haeckel, 1879, p. 294, pl. 18, fig. 7.)

Station 4948, 650–0 fathoms; 1 specimen, 25 mm. in diameter; fragmentary.

Station 4952, surface; 1 specimen, 22 mm. in diameter; fragmentary.

Both of the specimens are hexamerous; that is, they have the normal number of radial canals. This is worth noticing only because the species is very variable, examples with 5 or 7 canals often being observed.

Order NARCOMEDUSAE.

Family CUNINIDAE[1] Bigelow

Family CUNANTHIDAE Haeckel (1879) (Maas 1904*a*, Bigelow 1909*a*.)

Genus SOLMISSUS Haeckel, 1879.

Solmissus MAAS (1904), BIGELOW (1909*a*), MAYER (1910).

Genus SOLMARIS Vanhöffen (1908) [part].

This genus, and Vanhöffen's treatment of the forms involved, is discussed in detail in my account of the Philippine Medusae, collected by the Fisheries steamer *Albatross*, and as that paper will probably appear before this one does, it would be a needless repetition to go into the matter here further than to point out that Vanhöffen has combined two totally distinct genera under the name *Solmaris*, and that his statement that all Solmarids have gastric pockets is based on misapprehension. That there are Solmarids without gastric pockets is now well established. Such forms, that is, those with neither otoporpae nor gastric pockets, have been described by Maas (1909, p. 34); and both Mayer (1910) and I have substantiated his account from excellent specimens of the well-known *Solmaris flavescens* from the Mediterranean.

The present collection contains several specimens of *Solmissus*, all more or less fragmentary, but still well enough preserved to show

[1] The name Cunanthidae, used by Maas (1904) and by me (1909*a*) is untenable, because *Cunantha* Haeckel is almost certainly larval *Aegina*.

Digitized by Google

that they probably belong to the form which I described from the eastern Pacific as *S. incisa* Fewkes. It is distinguished from the better known *marshalli* and *albescens* by its much more numerous antimeres and less numerous otocysts, as well as by its rounded gastric pockets and very large size. Probably *S. faberi* and *S. bleekii* of Haeckel are synonyms of *incisa* (Bigelow, 1909*a*, p. 64), and the *Solmaris rhodoloma* of Vanhöffen (1908), which likewise has a large number of tentacles, can not be distinguished from *incisa*, so far as his brief account of rather fragmentary specimens shows.

SOLMISSUS INCISA (Fewkes).

Solmaris incisa FEWKES, 1886, p. 954, pl. 9.—BIGELOW, 1909*a*, p. 67, pl. 21, figs. 1–3, 5.—MAYER, 1910, p. 483

Solmissus faberi HAECKEL, 1879, p. 350.

Solmissus bleekii HAECKEL, 1879, p. 351.

? *Solmaris rhodoloma* VANHÖFFEN, 1908, p. 60, pl. 1, fig. 5 (not Brandt, 1838).

The series gives the following data:

Station.	Depth, fathoms.	Number of specimens.	Diameter, mm.	Number of tentacles.
4759	2708–0	1	48	22
4760	300–0	1	50	23
4763	300–0	2	40 and 103	20 and 35
4775	300–0	1	44	23
4785	300–0	1	45	19
4793	300–0	5	76, 60, 65, 75, 112	40, 31, 34, 35, 35
5058	300–0	1	43	24
5063	300–0	1	43	19

Fragments probably belonging to this species were taken at stations 4758, 4766, 4767, 4774, and 4797, in the trawl or in "intermediate" hauls.

The specimens are all in poor condition, being variously torn and distorted, with the entire lower wall of the gastric system torn away, except around the margins of the gastric pockets and in the septal regions separating them. Consequently I can add little to my previous account.

The most valuable thing about the series is the data which it affords as to the number of antimeres and tentacles. In the eastern Pacific series they ranged from 16 to 31 in specimens 10–68 mm. in diameter, all the large ones (17 mm. or upward) having upward of 20. And Vanhöffen's specimens of 71, 75, and 82 mm., which probably belong here, had 30, 28, and 29, respectively.

These numbers, together with those listed above, show that the tentacles increase irregularly with growth (a specimen of 45 mm. has 19, another smaller one, of 43 mm., has 24), and that in large specimens there are always many more tentacles than in either *marshalli* or *albescens*, for both of which 16 is the maximum yet recorded.

No otocysts were found, but the pads on which these organs were situated are preserved in a few antimeres of the largest specimens, the

Digitized by Google

number varying from 2–4 to the antimere. This is the same number which I counted in the eastern Pacific specimens (2–3 to the antimere, 1909*a*, p. 69), and Haeckel's specimens, too, had very few (1–3 to the lappet). In *marshalli* and *albescens* there are many more otocysts in each antimere, up to 15 having been recorded for the former and 10 for the latter.

Genus CUNINA Eschscholtz, 1829.

CUNINA PEREGRINA Bigelow.

Cunina peregrina BIGELOW, 1909*a*, p. 59, pl. 1, fig. 6; pl. 15, figs. 1, 2; pl. 28, figs. 1–7; pl. 45, fig. 8.

Station 4978, surface; 1 specimen, in fair condition.

C. peregrina has been recorded from Japan by Maas (1909).

Family AEGINIDAE Gegenbaur, 1856.

Genus AEGINA Eschscholtz, 1829.

Sensu MAAS (1904, 1905), BIGELOW (1909*a*).

Recent studies by Vanhöffen (1908) and by Maas (1909), and my own examination of the Fisheries steamer *Albatross* Philippine collection have shown that my union (1909*a*) of *A. rosea* with *A. citrea* was incorrect, because the former is separated from the latter both by color and by the important fact that the eight gastric pouches (four double pouches) are not further subdivided even in large specimens, whereas in *citrea* each is deeply notched at the margin at maturity. And the difference has been established on sufficiently large numbers of specimens to show that it deserves recognition.

The eastern Pacific collection was all of the *citrea* type except for one specimen which had four gastric pockets alternating with the four peroniae, and which I made the basis of a new species, *A. alternans*. But the present series shows that this specimen was merely an abnormal, or perhaps regenerated, *rosea*, and the name must therefore be abandoned. It is probable that all the Aeginas yet described belong either to *rosea* or to *citrea*, for *A. rhodina* Haeckel, recently redescribed by Mayer (1910), agrees with *rosea* in its gastric pouches; the large specimens recorded by Haeckel were no doubt *rosea;* the small one, of 7 mm., studied by Mayer, might equally well be the young of *rosea* or of *citrea*. Vanhöffen's *lactea* is separated from *rosea* only by the absence of color over the gastric system, and his *brunnea* by the brown color of the stomach. These are known from one specimen each; far too little material to show that these color differences have any phylogenetic meaning. Even if we leave these three forms out of account, *rosea* and *citrea* are both known from the Atlantic as well as from the Indo-Pacific (Maas, 1909; Vanhöffen, 1908).

Digitized by Google

AEGINA ROSEA Eschscholtz.

Aegina rosea ESCHSCHOLTZ, 1829, p. 115, pl. 11, fig. 4.—VANHÖFFEN, 1908, p. 48, pl. 7, figs. 1, 2; pl. 9, figs. 16–19.—MAAS, 1909, p. 35.
Aegina alternans BIGELOW, 1909*a*, p. 74, pl. 17, fig. 1.

Station 4761, 1973–0 fathoms; 1 specimen, 35 mm. in diameter.
Station 4774, 557–0 fathoms; 1 specimen, 40 mm. in diameter.
Both are rather fragmentary.

The large specimen agrees so well with my *A. alternans*, except that it has five antimeres, that I had no doubt at first that I was dealing with a second representative of that species, and consequently that its validity was fairly well assured. But when I examined the smaller one I saw at once that this was not the case. The distinctive feature of *alternans* was that it had four gastric pouches alternating with the canals, and not divided at all in the interradii, and this is exactly the condition in the specimen from station 4761. But in the other, which has six tentacles, two of the antimeres have two pouches each, discontinuous in the interradii exactly as in the other Aeginas, three have a single undivided pouch, as *alternans;* but the sixth gives us the clue, for in this one the interradial septum separating the two pouches has broken down distally, putting the two cavities into communication with each other, though its proximal portion remains intact. The specimen is so large that the exact state of affairs is easily traced, and the fact that in the antimeres in which the pouches are confluent there is no visible evidence that a septum formerly existed explains my failure see an indication of anything of the sort in the original specimen of "*alternans.*"

AEGINA CITREA Eschscholtz.

Aegina citrea ESCHSCHOLTZ, 1829, p. 113, pl. 11, fig. 4.

(For synonymy, see Mayer, 1910, p. 451.)

Station 4757, depth?; 1 specimen, 29 mm. in diameter, with four antimeres, rather fragmentary; in alcohol.

Station 4978, surface; 1 specimen, 15 mm. in diameter, with four antimeres.

The specimens add nothing, except the record of occurrence, to our knowledge of the species. The identification rests on the fact that the 8 gastric pockets are subdivided into 16 by deep marginal notches, exactly as in the eastern Pacific examples (1909*a*).

AEGINA, species?

Station 4762, 50–0 fathoms; 2 specimens, 7 and 9 mm. in diameter.
Station 4785, 300–0 fathoms; 3 specimens, 6 and 7 mm. in diameter.
Station 4793, 300–0 fathoms; 4 specimens, 5–8 mm. in diameter.
Station 4797, 300–0 fathoms; 2 specimens, 6 and 10 mm. in diameter.

Digitized by Google

Station 4805, 200–0 fathoms; 2 specimens, 7 and 10 mm. in diameter.

Station 4806, 200–0 fathoms; 1 specimen, 6 mm. in diameter.

In these young Aeginas the 8 gastric pouches (all have 4 antimeres) are not divided secondarily, and in our present comparative ignorance of the growth-stages of the genus, it is impossible to be certain whether they belong to *rosea* or to *citrea*.

None of them are in good enough condition for me to count the otocysts.

Genus AEGINURA Haeckel, 1879.

Aeginura MAAS (1904*b*; 1905).—BIGELOW (1909*a*).—MAYER (1910).
Cunoctona HAECKEL (1879).—VANHÖFFEN (1908).

Aeginidae with 8 tentacles and 16 gastric pockets: with secondary tentacles on the margin of the lappets.

There is no need to repeat the history of this genus here. Maas's (1904*b*) choice of *Aeginura* as the generic name for the deeply pigmented mesoplanktonic Aeginids with 8 tentacles, which have been brought to light by the recent deep-sea explorations of the Prince of Monaco, the *Siboga*, and the *Albatross*, seems to be justified by a strong probability that they are congeneric with Haeckel's *A. myosura*. A different stand is taken by Vanhöffen (1908), who refers them to Haeckel's *Cunoctona*, on the ground that the latter has no peripheral canal system, whereas his *Aeginura* had. It is true that Haeckel's figures of the latter apparently show a well developed system of canals, though Maas (1905, p. 79) has pointed out that the "canals" in Haeckel's section (1881, pl. 13, fig. 7) are in reality portions of the gastric pockets themselves, such as are to be seen in a corresponding figure of one of the *Siboga* specimens (Maas, 1905, pl. 14, fig. 92).

Vanhöffen (1908) found no canals in the sections of the margin which he studied, and though Maas (1905) observed and figured spaces in the entodermic lamella in exactly the region where canals would be expected, these probably did not indicate the existence of canals, because there was no definite endothelial layer surrounding them. On the other hand, Haeckel's figure of *Cunoctona* certainly suggests the presence of canals, though whether or not it actually had them is not certain. Under these circumstances it seems idle to try to derive a generic character from the presence or absence of canals in Haeckel's specimens. Another objection to referring the Aeginuras of modern authors to *Aeginura* Haeckel is the fact that he saw no secondary tentacles, while he figures very large otocyst-clubs. But his figure is obviously more or less reconstructed, and the

Digitized by Google

secondary tentacles may well have been lost in his specimen, or he may have mistaken them for otocysts.

As to Haeckel's *Cunoctona*, I must point out that if we are to unite it with *Aeginura* we must suppose that its otoporpae, which he shows so clearly, were imaginary. And it is not clear whether its gastric pouches were actually of the bifid, Aeginid type, for though they are so shown in the side view (Haeckel, 1879, pl. 20, fig. 2), in the oral view (1879, pl. 20, fig. 1), which is much the more detailed, they are hardly notched at all in the perradii, that is, they are more nearly of the *Cunina* type.

The modern Aeginuras are *grimaldii* and *weberi* of Maas, and *grimaldi* var. *munda*, *guinensis*, and *obscura* described as new by Vanhöffen from the collections of the *Valdivia*. I have already given my reasons (1909*a*) for uniting the first two, as does Mayer also (1910), and for calling the eastern Pacific specimens *grimaldii*. Vanhöffen's species are based on the number of secondary tentacles and on slight differences in color. But the present series shows that the first of these characters is too variable, even from octant to octant of a given individual, to be of any value in classification, at least within the narrow limits laid down by Vanhöffen; and it also affords evidence that the second is of no greater importance.

All of these forms are therefore united here as *grimaldii*.

AEGINURA GRIMALDII Maas.

Aeginura grimaldii Maas, 1904*b*, p. 38, pl. 3, fig. 19–28.—Bigelow, 1909*a*, p. 80, pl. 9, fig. 4.—Mayer, 1910, p. 470.
Aeginura weberi Maas. 1905, p. 77.
Cunoctona grimaldi, var. *munda* Vanhöffen, 1908, p. 53, pl. 2, fig. 6.
Cunoctona guinensis Vanhöffen, 1908, p. 53, pl. 3, fig. 29.
Cunoctona obscura Vanhöffen, 1908, p. 52, pl. 2, fig. 7; pl. 3, figs. 25–28, 30.

Station 4764, 1130–0 fathoms; 3 specimens, 26, 27, and 30 mm. in diameter.

Station 4766, 300–0 fathoms; 1 specimen, 32 mm. in diameter.

Station 4768, 764–0 fathoms; 1 specimen, 20 mm. in diameter.

Station 4780, 1046–0 fathoms; 7 specimens, 20–30 mm. in diameter, fragmentary.

Station 4953, 1350–0 fathoms; 1 specimen, 15 mm. in diameter.

Station 5058, 300–0 fathoms; 1 specimen, 22 mm. in diameter.

Station 5084, 300–0 fathoms; 1 specimen, 15 mm. in diameter; fragmentary.

In their general organization these specimens agree so well with Maas's (1905) excellent account of the *Siboga* material, and with the eastern Pacific series (1909*a*, p. 80) that an extended account is unnecessary. The most important point which they illustrate is the futility of trying to base several species on the number of secondary tentacles per octant. The largest example is in good condition, and

Digitized by Google

though the others are all more or less battered, their margins are well enough preserved to afford the following data:

Diameter, mm.	Antimeres.	Secondary tentacles in successive antimeres.
32	7	4, 4, 3, 4, 5, 5, 5
27	8	3, 3, 3
22	8	3, 3, 4, 3, 3, 5, (?), (?)
15	8	2, 3, 3

The previous records are:

23 (?) mm., 3 secondary tentacles per octant (Maas, "Monaco").

35–45 mm., 3 secondary tentacles per octant (Maas, *Siboga*).

16–21 mm., usually 3 secondary tentacles per octant (Bigelow, 1909*a*, *Albatross*).

8 and 16 mm., 3 secondary tentacles per octant (Vanhöffen, 1908, var. *munda*).

Diam. ?, 5 secondary tentacles per octant (Vanhöffen, 1908, *guinensis*).

34 mm., 4 secondary tentacles per octant (Vanhöffen, 1908, *obscura*.

The value of these records must be modified by the statement that the margin in the "Monaco" specimen, and most of the *Albatross* eastern Pacific ones, was in such poor condition that the counts given are only approximate. Some of the octants of the latter could not be counted at all, and in others some of the secondary tentacles may have been lost.

Vanhöffen's definition of the various species is: with 3 secondary tentacles to the octant, *grimaldii;* with 4, *obscura;* with 5, *guinensis*. But the present series shows that it is impossible to draw any such lines, because a single specimen may show all three conditions on different parts of the margin; that is, its individual antimeres, on this system, would belong to different species. The number of secondary tentacles increases with growth, but very irregularly. Thus the largest number observed for any antimere, 5, occurs in a specimen of only 22 mm., as well as in the largest, while the only one which has 3 in 3 successive octants is 27 mm. in diameter. Nor is it safe to assume that more than 5 may not be developed.

The general rule, according to both Maas and Vanhöffen, is that there is an otocyst on either side of each secondary tentacle; and that is the case in the present series wherever the otocysts are intact. But in no specimen could I count them even over the whole of a single antimere.

In the largest specimen, one in which the central gastric system is well preserved, the interradial incisions between the gastric pockets are fully twice as deep as the incisions in the perradii, a discrepancy

Digitized by Google

even greater than that observed by Maas (1905) and by me (1909*a*). As pointed out elsewhere, this fact is probably of phylogenetic importance, showing that the pockets are primarily radial, as in *Cunina*.

This specimen is a female with large eggs, and it shows that the reason that the eggs in the large eastern Pacific example showed white (1909*a*, pl. 9, fig. 4) was that the overlying tissue was torn, or at least that the pigment was destroyed. In the present case they are made visible only by the swellings which they cause, exactly as in *Solmissus marshalli* (1909*a*, pl. 21, fig. 7).

Color.—In the best preserved specimens the central stomach and gastric pouches are very dense, opaque, chocolate-brown, with more or less pronounced reddish tinge, with the marginal region of the subumbrella pale reddish; i. e., of about the same color as the specimens of the species previously recorded.

In the two specimens named by Vanhöffen var. *munda*, the marginal region was white; and this was their sole distinguishing character. But there is no sharp line between them and specimens with pale reddish margin and his own *obscura* in which the marginal region was densely pigmented.

Genus SOLMUNDELLA Haeckel, 1879.

Solmundella MAAS (1904*b*, 1905).—BROWNE (1905*b*).—BIGELOW (1909*a*).

This genus has been so thoroughly discussed by Maas (1905), Browne (1905*b*), Mayer (1910), Vanhöffen (1908), and me (1909*a*), that all that is necessary here is to record the 17 specimens contained in the collection.

SOLMUNDELLA BITENTACULATA (Quoy and Gaimard).

Charybdea bitentaculata QUOY and GAIMARD, 1834, p. 295, pl. 25, figs. 4, 5.
(For synonymy, see Bigelow, 1909*a*, p. 77; Mayer, 1910, p. 455.)

Station 4800, 300–0 fathoms; 3 specimens, fragmentary.
Station 4896, depth ?; 2 specimens, 3 and 5 mm. in diameter.
Station 4920, 300–0 fathoms; 10 specimens, 6–10 mm. in diameter.
Station 4952, surface; 2 specimens, 1.5 mm. in diameter.

None of the specimens are in good enough condition for me to count the otocysts.

Class SIPHONOPHORAE.

Order CALYCOPHORAE.

Family SPHAERONECTIDAE Huxley, 1859.

Genus NECTOPYRAMIS Bigelow, 1911.

NECTOPYRAMIS DIOMEDAE Bigelow.

Nectopyramis diomedae BIGELOW, 1911*b*, p. 191, pl. 1, fig. 1–6.

Station 4759, 300–0 fathoms; 1 eudoxid, good condition.
Station 4806, 200–0 fathoms; 1 eudoxid; fragmentary.

Digitized by Google

These eudoxids, in both of which the bract is 25 mm. long, agree very well with one of corresponding size from the eastern Pacific. The best one is somewhat younger than the one I have figured (1911*b*, pl. 1, fig. 5), its apical canal giving off only four branches instead of six, the odd basal canal three instead of four. But these differences are only indications of differences in development. Its tentacles and gonophores are not in good enough condition to add anything to my previous account.

The polygastric state is not represented in the collection.

Family PRAYIDAE Kölliker, 1853.

Genus ROSACEA Quoy and Gaimard, 1827.

ROSACEA PLICATA Quoy and Gaimard.

Plate 5, figs. 10, 11.

Rosacea plicata QUOY and GAIMARD, 1827, p. 147, pl. 4 B.

(For discussion and synonymy of this species, see Bigelow, 1911*b*, pp. 197, 201.)

Station 4764, 1130–0 fathoms; 2 loose nectophores.

Station 4766, 300–0 fathoms; 1 complete specimen, 9 loose nectophores.

Station 4767, 300–0 fathoms; 2 complete specimens, 2 loose nectophores.

Station 4775, 200–0 fathoms; 1 complete specimen, 3 loose nectophores.

Station 4785, 300–0 fathoms; 1 complete specimen, 19 loose nectophores.

Station 4785, 300–0 fathoms; 2 loose nectophores.

Station 4800, 300–0 fathoms; 1 complete specimen, 16 loose nectophores.

Station 4865, 200–0 fathoms; 9 loose nectophores.

Station 4902, 432–0 fathoms; 2 loose nectophores.

Station 4920, 300–0 fathoms; 2 loose nectophores.

Forty-five of the loose nectophores are younger (superior), and 21 older (inferior). The largest nectophores are about 30 mm. long.

The series is tantalizing, for although the nectophores are in good condition, the stems are invariably broken off short, so that the most important question, that is, whether there are special nectophores in the cormidia, must remain unanswered. The evidence that *R. plicata* does have such organs is not as conclusive as might be supposed, for nothing of the sort is shown by Keferstein and Ehlers (1861, "*P. diphyes*") or by Kölliker (1853*b*, "*P. diphyes*"), and the special nectophore in Vogt's figure (1854, "*P. diphyes*") might be a

Digitized by Google

gonophore which had lost its spadix. In the Biscayan series of *plicata* (1911*b*), I found what appeared to be a typical special nectophore, in addition to gonophores, in one cormidium. But we must remember that such a structure might be interpreted as an abortive gonophore in which the spadix had failed to develop. A single specimen with the whole stem intact would settle the question at once; and until some student can examine such material further discussion is idle. But it must be observed that if it should prove that *R. plicata* has no special nectophores, but only gonophores, there would be no generic distinction between it and *Praya cymbiformis*.

The nectophores in the present series (pl. 5, fig. 10) agree with the Biscayan and eastern Pacific ones in their short broad outlines and in the very deep hydroecium, and it is on the strength of these features that I have united the Biscayan, eastern Pacific, and northwestern Pacific specimens.

In the only other species with which they could be confused, *Praya cymbiformis*, the nectophores are proportionately narrower, with hydroecium shallower, and of almost equal depth from end to end, and as the difference seems to be constant, it would separate the two forms specifically, even if it does eventually prove that they belong to a single genus. The older (inferior) nectophores of *plicata* can not be distinguished from those of *cymbiformis* (1911*b*).

Stem and appendages.—Only young siphons, gonophores, and bracts remain attached, and none of these are sufficiently advanced to show whether there is any important difference between them and the corresponding organs in *cymbiformis*, nor did the eastern Pacific series prove any more helpful.

In none of the eastern Pacific specimens was the somatocyst terminally dilated, whereas in the Biscayan series it varied from being slightly thickened at the tip to having an egg-shaped terminal swelling (pl. 5, fig. 11). But the present series shows that the difference is due either to contraction or to individual variation, for one specimen has a well-marked dilation, some are slightly thickened, and others retain an even caliber to the tip.

Genus NECTODROMA Bigelow, 1911.

NECTODROMA RETICULATA Bigelow.

Nectodroma reticulata BIGELOW, 1911*b*, p. 206, pl. 1, figs. 7, 8; pl. 3, figs. 1–7.

Station 4928, 300–0 fathoms; 2 nectophores, which probably belong together, though now separate, 42 and 50 mm. long; 4 bracts.

The nectophores, though not perfect, are in sufficiently good condition to show that they agree in all their essentials, as well as in

Digitized by Google

general form, with the type specimen. Fortunately the apical portion of the subumbrella of each is intact, and shows the network of subumbral canals, which is the chief characteristic of the species. The only point in which they differ from the eastern Pacific material is that in the smaller nectophore the descending arm of the somatocyst has no branches and the ascending one only 6, instead of about 18, short transverse branches. The lateral branches of the dorsoventral extension, too, are fewer, and even shorter. But there is no reason to suppose that these differences are anything but evidence of an earlier stage in development. In the larger nectophore the somatocyst is largely destroyed.

The four bracts *captured* with the nectophores agree very well with the ones collected with the type specimen (1911*b*, pl. 3, fig. 6), and the fact that the bracts of this type have now been taken twice with the nectophores is almost proof positive that they belong together.

Family HIPPOPODIIDÆ Kölliker, 1853.

Genus HIPPOPODIUS Quoy and Gaimard, 1827.

HIPPOPODIUS HIPPOPUS (Forskål).

Gleba hippopus FORSKÅL, 1775, p. 14; 1776, pl. 43, fig. E.

(For synonymy, see Bigelow, 1911*b*, p. 208.)

Station 4951, 300–0 fathoms; 1 small specimen with 4 nectophores.

As was to be expected, this example shows nothing to separate it from the tropical Pacific or Atlantic specimens, with which I have compared them.

Genus VOGTIA Kölliker, 1853.

VOGTIA PENTACANTHA Kölliker.

Plate 5, figs. 7–9; plate 6, fig. 6.

Vogtia pentacantha KÖLLIKER, 1853*b*, p. 31, pl. 8.—KEFERSTEIN and EHLERS, 1861, p. 23, pl. 5, figs. 12–15.—CHUN, 1897*b*, p. 35, pl. 1, figs. 11–14.—BIGELOW, 1911*a*, p. 351; 1911*b*, p. 210.

Hippopodius pentacanthus CLAUS, 1863, p. 551, pl. 47, figs. 23–25.—SCHNEIDER, 1898, p. 84.

Station 4763, surface; 2 colonies with 3 and 5 nectophores and 39 loose nectophores.

Station 4766, 300–0 fathoms; 1 colony with 11 nectophores, in excellent condition.

Station 4785, 300–0 fathoms; 1 colony with 3 nectophores and 7 loose nectophores.

Station 4797, 300–0 fathoms; 2 colonies with 3 and 6 nectophores and 9 loose nectophores.

Digitized by Google

Station 4800, 300–0 fathoms; 3 colonies with 5, 5, and 6 nectophores and 16 loose nectophores.

Station 4897, 300–0 fathoms; 6 loose nectophores.

Station 4928, 300–0 fathoms; part of a colony with 3 nectophores.

Station 4951, 300–0 fathoms; part of a colony with 3 nectophores.

Station 5030, 300–0 fathoms; 3 colonies with 6, 6, and 7 nectophores and 14 loose nectophores.

As a whole, the material is in good condition, but the stem is invariably so strongly contracted that it is difficult to disentangle the prolonged "knospungzone," which bears the nectophores, from it.

These specimens are especially interesting, because comparison between them and the eastern Pacific series of *V. spinosa* shows that the difference in the conformation of the nectophores which has been used to separate the two specifically (1911*b*) is visible from a very early stage in development. In *spinosa* the nectophores are spinous on the lateral and dorsal facets, as well as on the margins of the facets. This type of spinosity is seen in very young nectophores as well as in older ones (1911*b*, pl. 15, figs. 9–11), but in *pentacantha* the surfaces of the facets are smooth at all ages (pl. 5, fig. 7).

It appears that there is a good deal of variation in the degree to which spines are developed on the ridges limiting the facets. Chun (1897*b*) shows numerous pointed spines in these regions, and the Biscayan specimen recorded by me was likewise slightly spinous on the margin of the facets. But in the present series the older nectophores have no spines at all. The ridges, like the facets, are perfectly smooth (pl. 5, fig. 7), though in very youngest nectophores the margins of the facets are always (?) more or less irregular (pl. 5, fig. 8), and I found one in which they are distinctly spinous.

The nectophores of the two species likewise differ in details of form, but this is more clearly shown by figures (pl. 5, fig. 7, 1911*b*, pl. 15, figs. 9, 10) than verbally.

Another feature which proves to be diagnostic is the "ventral sinus," into which the ventral subumbral canal is expanded. In *spinosa* this cavity covers nearly the whole of the upper surface of the subumbrella in very young nectophores, and as growth progresses it becomes gradually obliterated, the coalescence progressing from the dorsal side and from the margins, in such a way that the sinus is finally narrowed to two lateral wings, which are narrowest next the canals (1911*b*, pl. 15, figs. 9, 12); and in this form it is to be seen in the largest nectophores which I examined.

In the youngest nectophores of *pentacantha* the sinus is smaller (pl. 5, fig. 8) than in *spinosa* at a corresponding stage, and with the growth of the bell it becomes narrower and narrower, taking on a heart-shaped (pl. 5, fig. 9) and finally a linear outline (pl. 5, fig. 7),

Digitized by Google

and in the largest nectophores it is represented merely by a slight thickening of the ventral canal.

In the general structure of the colony, in the arrangement of the nectophores, and in size, *pentacantha* very closely resembles *spinosa*. One of the specimens is in good enough condition to show that the nectophores are borne on an elongate "Knospungzone" (pl. 6, fig. 6), just exactly as in *Hippopodius*, and the same is true of *V. spinosa* (fig. 1), as I have previously pointed out (1911*b*, p. 211). Chun (1897*a*) has given a very good figure and an account of the relation of nectophores to stem in *Hippopodius*, and as the two genera are built on exactly the same plan in this respect, no further account is needed here. Each cormidium, as in *spinosa*, consists of siphon with its tentacles, and gonophores, both female and male, but not bract. Palpons are absent, as indeed in all Calycophores.

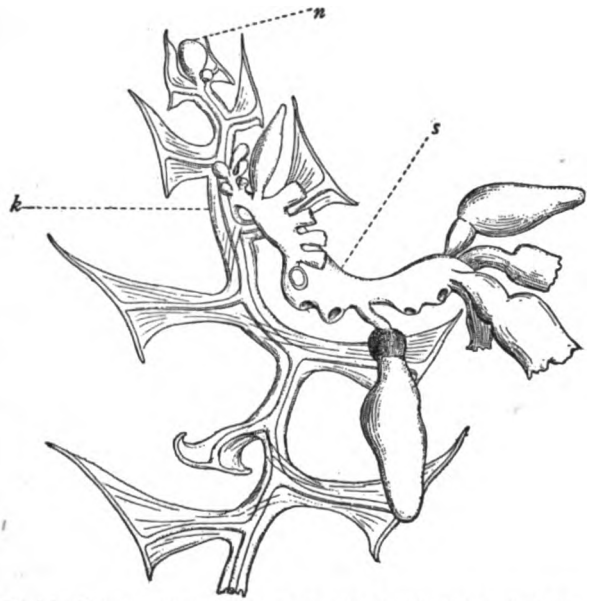


FIG. 1.—VOGTIA SPINOSA. MOST OF THE APPENDAGES AND NECTOPHORES ARE STRIPPED OFF, TO SHOW THE RELATIONSHIP OF THE STEM *s* TO THE ELONGATED "KNOSPUNGZONE" *k* WHICH BEARS THE NECTOPHORES. *n*, YOUNG NECTOPHORE.

Family DIPHYIDAE Eschscholtz, 1829.

Subfamily ABYLINAE L. Agassiz, 1862.

Genus ABYLOPSIS Chun, 1888.

ABYLOPSIS TETRAGONA (Otto) Bigelow.

Pyramis tetragona Otto, 1823, p. 306, pl. 42, figs. 2*a*–2*e*.

(For synonymy, see Bigelow, 1911*b*, p. 224).

Station 4906, 369–0 fathoms; 1 entire colony.
Station 4928, 300–0 fathoms; 8 entire colonies.
Station 4930, 300–0 fathoms; 3 entire colonies.

Digitized by Google

Station 4951, 300–0 fathoms; 1 entire colony.

Station 5064, 300–0 fathoms; 4 entire colonies.

The proportions of the smallest are, superior nectophore 5 mm. long, inferior one 11 mm.; of the largest, superior nectophore 6 mm., inferior 16 mm.

These few specimens, not in very good condition, agree very well with the previous accounts of this well-known species. The distinctions between *tetragona* and *eschscholtzi* are given elsewhere (1911*b*, p. 216), the most important being the course of the canals of the posterior nectosac (1911*b*, pl. 14, fig. 7).

ABYLOPSIS ESCHSCHOLTZII (Huxley).

Aglaismoides eschscholtzii HUXLEY, 1859, p. 60, pl. 4, fig. 2.

(For synonymy and description, see Bigelow, 1911*b*, p. 226.)

Station 4928, surface; 1 specimen with both nectophores.

Genus BASSIA L. Agassiz, 1862.

BASSIA BASSENSIS (Quoy and Gaimard) Bigelow.

Diphyes bassensis QUOY and GAIMARD, 1834, p. 91, pl. 7, figs. 18–20.

(For synonymy, see Bigelow, 1911*b*, p. 229.)

Station 4921, surface; 1 superior and 6 inferior nectophores.

Station 4952, surface; 3 superior and 9 inferior nectophores.

The material is not in good condition, being more or less crumpled, and all the nectophores are detached and stems and appendages lost; but the nectophores, particularly the posterior ones, are sufficiently well preserved to show their identity.

Subfamily GALEOLARINAE Chun, 1897.

Genus GALEOLARIA Blainville, 1834.

GALEOLARIA AUSTRALIS Quoy and Gaimard,

Plate 5, fig. 6.

Galeolaria australis QUOY and GAIMARD, 1834, p. 42, pl. 5, figs. 29–31.
(For a discussion of the history and synonymy of this species, see Bigelow, 1911*b*, pp. 233, 238.)

Station 4952, surface; 45 anterior and 13 posterior nectophores; the largest of the former is 16 mm. long, of the latter 12 mm.

Station 4955, surface; about 40 superior nectophores.

Station 4978, surface; 16 superior nectophores.

The material is in good condition and has been compared with more extensive material from the eastern Pacific. The anterior nectophore is characterized by having two large ventral wings, but no dorso-basal or latero-basal teeth; the posterior nectophore by

Digitized by Google

the absence of basal teeth and by the presence of an undivided basal wing. Unfortunately the stems, with their appendages, are lost in all cases.

GALEOLARIA MONOICA (Chun).

Epibulia monoica CHUN, 1888, p. 1157.
(For synonymy, see Bigelow, 1911*b*, p. 239.)

Station 4955, surface; 2 anterior, 4 posterior nectophores.

Station 4978, surface; about 30 anterior and 30 posterior nectophores.

Identification rests on comparison with the more extensive series from the eastern Pacific.

CLAUSOPHYINÆ, new subfamily.

Genus CLAUSOPHYES Lens and Van Riemsdijk, 1908.

Diphyes KEFERSTEIN and EHLERS, 1861 (part).
Galeolaria CHUN, 1897*b* (part).

In 1861 Keferstein and Ehlers described a peculiar Diphyid, *Diphyes ovata*, taken in the Straits of Messina, in which the posterior as well as the anterior nectophore had a well-developed somatocyst, as in the Prayids, although the two bells were of different outlines and one superposed upon the other, as is the case in all Diphyids. Chun (1897*b*) has suggested that *D. ovata* is actually intermediate between the two groups, but since no one since 1861 has seen a siphonophore answering to the original account of *D. ovata*, it has remained a more or less problematical form. For this reason I thought it wisest not to lay much stress upon it in my discussion of the relationships and classification of the Calycophorae (1911*b*, p. 179).

It is now my good fortune to announce the discovery of three complete specimens and a loose posterior nectophore which agree with the account of Keferstein and Ehlers in all their main features. The most interesting feature of the animal is, of course, the fact that the posterior nectophore has a well-developed somatocyst, and the material is in good enough condition to allow this statement to be made without hesitation. In this it differs from all Diphyids, for though Chun (1897*b*) states that he was able to distinguish the rudiments of a somatocyst in all the posterior bells of *Galeolaria* studied by him, there is good reason to believe that what he saw was a part of the common muscular lamella to which both the nectophores are attached, or the dorsal extension of the pedicular canal beyond the point at which it joins the lamella (pl. 5, fig. 6). This prolongation of the canal is likewise to be seen in the anterior nectophore, in which the somatocyst arises from it. But there is no trace of anything corresponding to a somatocyst in any of the many posterior bells of

Digitized by Google

Galeolaria which I have examined. This being the case, *D. ovata* is not a *Galeolaria;* and at first I thought a new genus must be instituted for it, but the figure by Lens and Van Riemsdijk (1908) of their problematical genus *Clausophyes* agrees so well with the posterior bell of the *Albatross* specimens that no doubt they are identical; especially since my series includes specimens from the Philippines.

The *Albatross* specimens of *Clausophyes* show that the genus has no real connection with the Prayidae. In the first place, though each nectophore has a somatocyst, the two bells are wholly dissimilar in form; and, more important is the fact that the somatocyst of the posterior one occupies a totally different position from that of the anterior bell. Furthermore, the somatocyst of the anterior bell is a special organ deeply embedded in the gelatinous substance, and that of the posterior one is structurally like it, whereas in all Prayids the somatocyst, or branching system which represents it (as in *Nectodroma*), is merely a slightly thickened extension of the canal system, structurally much simpler than the somatocyst in Diphyds, though fundamentally homologous with it.

These facts point to the conclusion that *Clausophyes* is not a link connecting the two families, but an offshoot of the Diphyidae, in which the canal system of the posterior nectophore has secondarily developed a somatocyst. General form suggests that its affinities are with the Galeolarinae; but it is so aberrant that it seems wisest to make it the type of a new subfamily.

It seems necessary to separate the *Siboga* and *Albatross* specimens specifically from the Mediterranean *ovata*, because the base of the posterior nectophore is provided with two large and noticeable teeth, whereas in *ovata* this region is represented as rounded (Keferstein and Ehlers, 1861, pl. 5, fig. 1), and because the basal teeth have proved to be valuable specific characters in the Diphyidae in general on account of their constancy. But fresh Mediterranean material must be examined before the matter can be settled definitely.

CLAUSOPHYES GALATEA Lens and Van Riemsdijk.

Plate 6, figs. 1, 2.

Clausophyes galatea LENS and VAN RIEMSDIJK, 1908, p. 12, pl. 1, figs. 6–8.

Station 4909, 300–0 fathoms; 2 upper and 2 lower nectophores; fragmentary.

Station 4954, south of Shikoku Island, Japan; 850–0 fathoms; 1 complete specimen and 1 loose posterior nectophore.

Station 5064, 300–0 fathoms; 1 upper and 1 lower nectophore.

Also Philippine Islands, *Albatross* station 5320, 1908; 1 upper and 1 lower nectophore.

The northwestern Pacific specimens have been flattened out more or less, the subumbral surfaces of the nectosac are largely destroyed, and

Digitized by Google

all but the basal portion of the stem lost; but the essential features of the somatocysts and nectophores are intact, while the Philippine specimen (with the bells separated) is in excellent condition. In the complete specimen the anterior nectophore is 13 mm. long, the posterior one 28 mm.

Anterior nectophore.—The surface of the anterior bell is rounded, with no ridges, either dorsal, lateral, or ventral, and with no basal teeth; its apex bluntly pointed; its general form that of an obliquely truncate cone (pl. 6, fig. 1). There is a shallow hydroecium, open along the ventral side for its whole length, and reaching nearly to the mid-level of the bell; the nectosac is large, reaching over two-thirds of the length of the bell, and the pedicular canal joins it at one-third of its height. Only the proximal ends of the subumbral canals can be traced. The somatocyst reaches almost to the apex; its proximal half is narrow, and in one specimen it continues thus, though wrinkled and twisted; but in another it dilates near its tip (pl. 6, fig. 1). This part of the somatocyst is injured, but its outlines can still be traced.

Posterior nectophore.—The surface is rounded, without ridges; the opening of the nectosac oblique, the flaps which inclose the hydroecium are separate from end to end, though the left-hand one overlaps the right hand. Below the level of the opening of the nectosac the dorsal wall of the hydroecium is prolonged in two large triangular, smooth-edged teeth, of about equal length (pl. 6, fig. 1), and these are shown by Lens and Van Riemsdijk (1908).

The pedicular canal joins the nectosac at about its mid-level; the subumbral canals are largely destroyed. The most interesting feature of the posterior nectophore is, of course, its somatocyst. This structure (pl. 6, figs. 1, 2) is a pear-shaped outgrowth of the pedicular canal close to the apex of the bell, and it lies close to the dorsal surface of the hydroecium, which reaches to the apex. Lens and Van Riemsdijk likewise observed it and suspected its true nature.

The relationship of the two bells to each other and to the stem differs in detail from what is found in *Galeolaria*, the two bells being less intimately connected, and the stem arising from the common pedicular canal after the latter has joined the ventral surface of the posterior nectophore (pl. 6, fig. 2). The result of this is that when the two nectophores are forcibly separated the stem remains attached to the posterior one, instead of to the anterior as in the Diphyopsinae. This phenomenon makes it improbable that there is a succession of nectophores in this genus, because the anatomy of the parts concerned suggests that if either bell were cast off it would be the anterior one.

Stem and appendages.—Unfortunately only the basal part of the stem is preserved in any specimen, and it is invariably so contracted

Digitized by Google

that all that is to be seen is a crowded mass of young siphons and gonophores. I could not find any bracts, but the material is not good enough to lay any stress on their apparent absence.

Subfamily DIPHYOPSINAE Haeckel, 1888.

Genus CHUNIPHYES Lens and Van Riemsdijk, 1908.

CHUNIPHYES MULTIDENTATA Lens and Van Riemsdijk.

Chuniphyes multidentata LENS and VAN RIEMSDIJK, 1908, p. 13, pl. 1, figs. 9–11; pl. 2, figs. 12–15.—BIGELOW, 1911*a*, p. 348; 1911*b*, p. 262, pl. 8, fig. 9; pl. 10, fig. 7; pl. 12, fig. 6.

Station 4759, 300–0 fathoms; 1 superior and 1 inferior nectophore, respectively 23 and 29 mm. long.

Station 4917, 361–0 fathoms; 1 inferior nectophore, about 20 mm. long.

Station 4920, 300–0 fathoms; 1 superior and 1 inferior nectophore.

The two nectophores from station 4920 and the pair from station 4759 are now separate, but as the members of the pairs were taken together it is probable that they are the components of two colonies.

The material is in good condition, and as it shows the characteristic conformation of the two nectophores in a typical fashion (Bigelow, 1911*b*) it can be identified with certainty. The superior nectophores are interesting, because they illustrate the variability of the somatocyst. I have already pointed out (1911*b*) that this structure is dilated shortly above its point of origin, and then contracts once more to run as a narrow tube nearly to the apex. In one eastern Pacific specimen the dilation was spherical (1911*b*, p. 263); in the Biscayan examples it consisted of two short transverse horns, one on either side, varying in size in different specimens (1911*a*, p. 349). In one of the present examples, likewise, the dilation projects on either side as a horn, one of which is almost twice as long as the other, but in the other the swelling is an irregular rhomboid, its lateral corners merely somewhat prolonged. This nearly bridges the gap between specimens with "horns" and one from the eastern Pacific with a spherical dilation. Unfortunately the stem is broken short off.

Genus DIPHYES Cuvier, 1817.

DIPHYES TRUNCATA Sars.

Plate 6, figs. 3, 4, 5.

Diphyes truncata SARS, 1846, p. 41, pl. 7, figs. 1–12.
Galeolaria truncata HUXLEY, 1859, p. 38.
Diphyes subtiloides LENS and VAN RIEMSDIJK, 1908, p. 46, pl. 7, figs. 59–61.
Muggiaea kochii BIGELOW, 1911*a*, p. 340; 1911*b*, p. 188, pl. 12, figs. 2–4.

Digitized by Google

The series described below is especially interesting because it shows that the siphonophore described by me from the Bay of Biscay (1911*a*) and from the eastern tropical Pacific (1911*b*) as "*Muggiaea kochii*" is not a Monophyid but a Diphyid, and the structure of the inferior nectophore as well as of the superior one identifies it positively with the *Diphyes truncata* of Sars (1846).

The *Diphyes subtiloides* of Lens and Van Riemsdijk (1908) is almost certainly identical, for their figures of its superior nectophore agree very well with small specimens in the *Albatross* series, especially in the shallowness of the hydroecium and length of the somatocyst. They did not find its inferior nectophore. Sars's species has usually been called a *Galeolaria;* but the structure of the upper nectophore suggests that it belongs to the Diphyopsinæ, though further data on the appendages (that is, whether or not they are set free as eudoxids) is needed to settle the question.

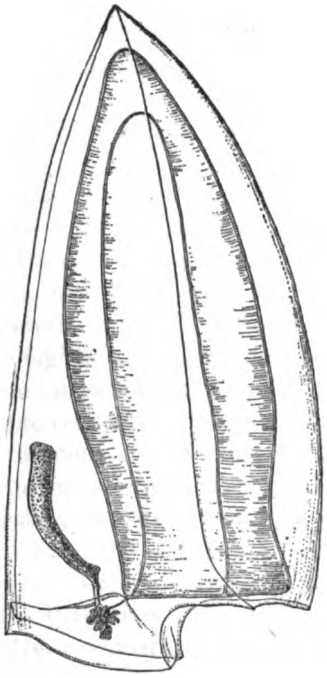


FIG. 2.—DIPHYES TRUNCATA, ANTERIOR NECTOPHORE, X 5.

It is not clear whether or not I was correct in believing that my Biscayan and eastern Pacific specimens belonged to the same species as the *Muggiaea kochii* of Chun, for the latter is insufficiently described, and the same is true of *Diphyes kochii* Will (1844). Should all finally be united, Will's name would, of course, take precedence.

Diphyes truncata is represented in the collection by 3 pairs of nectophores (now separated, but connected when taken), 32 loose superior nectophores, and 1 loose posterior one, all in fairly good condition, from stations 4759, 4760, 4763, 4766, 4767, 4775, 4785, 4793, 4797, 4896, 4955; and by a considerable number of nectophores, both superior and inferior, from station 4757, which were preserved in alcohol, and are now so flattened and distorted that they are useless for description, though their identity is evident.

Superior nectophore.—Nectophores 3–4 mm. long were taken at stations 4896 and 4955; the others range in length from 13 to 28 mm. The distinctive characters of the superior nectophore, as I have pointed out elsewhere (1911*b*), are the presence of five ridges from the apex; the very shallow hydroecium lying wholly below the opening of the nectosac; the fact that the dorsal wall of the hydroecium

Digitized by Google

is divided into two wings, and the considerable length of the somatocyst. The latter organ is fusiform (never globular and transverse as in *D. fowleri* Bigelow) and usually about one-third as long as the nectosac, but it may be variously contracted (fig. 2) with preservation, and in two specimens it reaches to about the mid-level of the nectosac; its normal length must be sought in living material.

The five ridges are usually perfectly smooth (fig. 2), as are the margins of the hydroecial opening, but in a few specimens slightly wavy, and in some the lateral ridges terminate just above the basal margin. But this is not invariable, as I formerly supposed, for in others the ridges can be followed to the margin. The shape of the hydroecium shown better in the figures (pl. 6, fig. 5) than by verbal description, is extremely characteristic.

The specimens agree very well with Sars's figures (1846, pl. 7, figs. 1–12). Thus he shows the five ridges and concave facets, and the moderately long fusiform somatocyst, and his figure (fig. 2) of the detached superior nectophore is especially important because it shows a very shallow hydroecium entirely below the opening of the nectosac, just as in our specimens (in his figure of the complete colony, the hydroecium is obscured).

Inferior nectophore.—The lower nectophore (pl. 6, fig. 3) is shorter than the upper one (superior 18 mm., inferior 12 mm.; superior 24 mm., inferior 17 mm.), somewhat quadrate in outline, with well-marked dorsal and lateral ridges; the hydroecium, open from end to end, indeed merely a furrow, deep near the apex, very shallow at the base, as in the genus *Galeolaria*. It resembles that genus, too, in the presence of a single basal hydroecial wing, incised in a characteristic way in its mid line, the right-hand lobe being the larger (pl. 6, fig. 4). The apex of the bell, too, recalls *Galeolaria*, for the pedicular canal joins the nectosac some little distance below its apex.

One specimen shows that the vascular system is of the usual Diphyid type.

Sars's (1846) figures of the lower nectophore agree with the above in general form and give a very clear account of the hydroecial groove, and it is especially important that he shows that his specimen agreed with ours in the outline of the basal wing (particularly in his side view, fig. 3), and apparently in the course of the lateral canals of the nectosac.

The present records are from the coasts of British Columbia, the Bering Sea region, and the Eastern Sea near the Goto Islands. The previous records are from Norway (Sars), the Bay of Biscay (1911*a*), the eastern tropical Pacific (1911*b*), and the Malaysian region (Lens and Van Riemsdijk).

The temperatures at which it has been taken range from 42° (or less?) to upward of 80° (Eastern Sea, Malaysia).

Digitized by Google

DIPHYES APPENDICULATA Eschscholtz.

Diphyes appendiculata ESCHSCHOLTZ, 1829, p. 138, pl. 12, fig. 7.

For synonymy, see Bigelow, 1911*b*, p. 248.

Station 4757, surface; 1 anterior nectophore, 14 mm. long.
Station 4920, 300–0 fathoms; 1 anterior nectophore, 10 mm. long.
Station 4928, 300–0 fathoms; 4 anterior nectophores.
Station 4955, surface; 1 anterior nectophore.
Station 5064, 300–0 fathoms; 1 anterior nectophore.

I have discussed this species at such length elsewhere (1911*b*) that I need only note that the identification of these specimens rests on actual comparison with specimens from the tropical Pacific, the Philippines, the West Indies, from the Mediterranean, and from the north Atlantic (Bay of Biscay). They clearly show the arrangement of the ridges at the apex, and the hydroecium, both of which are characteristic.

DIPHYES CONTORTA Lens and Van Riemsdijk.

Diphyes contorta LENS and VAN RIEMSDIJK, 1908, p. 39, pl. 6, figs. 48–50.—BIGELOW, 1911*b*, p. 254, pl. 7, figs. 7, 8; pl. 11, fig. 2.

Station 4896, surface; 38 anterior nectophores, 4–5 mm. long.
Station 4928, 300–0 fathoms; 5 anterior nectophores, 4 mm. long.

These small specimens agree very well with the larger ones taken by the Fisheries steamer *Albatross* in the eastern Pacific, except that none of them show the bud for an inferior nectophore.

DIPHYES SPIRALIS Bigelow.

Diphyes spiralis BIGELOW, 1911*b*, p. 249, pl. 7, fig. 4; pl. 8, figs. 1, 2; pl. 9, fig. 3; pl. 11, fig. 4.

Station 4954, 300–0 fathoms; 1 anterior nectophore.
Station 4955, surface; 1 anterior nectophore.

DIPHYES ARCTICA Chun.

Diphyes arctica CHUN, 1897*b*, p. 19, pl. 1, figs. 1–10.

For synonymy, see Bigelow, 1911*b*, p. 347.

Station 4760, 300–0 fathoms; 6 anterior nectophores.
Station 4763, 300–0 fathoms; 6 anterior nectophores.
Station 4767, 300–0 fathoms; 5 anterior nectophores.
Station 4785, 300–0 fathoms; 13 anterior nectophores.
Station 4793, 300–0 fathoms; 22 anterior nectophores.
Station 4797, 300–0 fathoms; 6 anterior nectophores.
Station 4800, 300–0 fathoms; 3 anterior nectophores.
Station 4805, 200–0 fathoms; 15 anterior nectophores.
Station 4806, 200–0 fathoms; 1 anterior nectophore.
Station 4820, 300–0 fathoms; 7 anterior nectophores.

Digitized by Google

These anterior nectophores range in length from 5 to 11 mm., and in four cases there is a young bud for an inferior nectophore.

Chun's account and figures of this species are so satisfactory that I can add little further than to note that the rounded apex, the peculiar hydroecium opening along the mid-ventral line, the fact that the dorsal hydroecial wall below the level of the bell opening is undivided, and the absence of basal teeth are all illustrated by our specimens. The hydroecium, especially, is so characteristic (Chun, 1897*b*, pl. 1, fig. 1–3) in its outlines as to identify the specimens at a glance. The somatocyst is rather long, reaching slightly above the mid-level of the bell cavity, and in our specimens it is abruptly truncate basally, connecting with the hydroecium at its dorsal edge (Chun, 1897*b*, pl. 1, fig. 1); but it may be rounded basally (Chun, 1897*b*, fig. 3), the difference being probably due to contraction.

In my Key to the Diphyopsinae (1911*b*, p. 247) this species was omitted, because I had never seen it and because Chun mentioned no details as to the number of ridges. In the present series the apex is evenly rounded, as Chun shows it (1897*b*, pl. 1, fig. 1), and there are no distinct ridges, either dorsal, lateral, or ventral, at any level; indeed, in this respect *D. arctica* suggests the allied genus *Galeolaria*, from which, however, it is separated by its deep hydroecium, and by the fact that its cormidia are set free as eudoxids.

All of the specimens are more or less contracted along the middle lateral line on either side, but as Chun's figures do not show this, it may be the result of contraction.

Inferior nectophores.—As noted above, four specimens have the bud for an inferior nectophore, but these are so young that they give no hint of their future form. Their presence, however, is important, because they corroborate Chun's (1897*b*) account, and are sufficient demonstrations that the species is a Diphyid, not a Monophyid. Only the basal parts of the stems are intact, and the siphons, gonophores, and bracts which are intact are so young that they add nothing to Chun's account.

Genus DIPHYOPSIS Haeckel, 1888.

DIPHYOPSIS DISPAR (Chamisso and Eysenhardt) Haeckel.

Diphyes dispar CHAMISSO and EYSENHARDT, 1821, p. 365, pl. 33, fig. 4.

(For synonymy, see Bigelow, 1911*b*, p. 257.)

Station 4896, surface; 4 anterior nectophores, 6 mm. long.

Station 4952, surface; 6 anterior nectophores, 8–11 mm. long.

Station 4955, surface; 1 anterior nectophore.

Station 4978, surface; 20 anterior nectophores and about 20 posterior nectophores.

Station 5064, 300–0 fathoms; 4 anterior nectophores.

Digitized by Google

I have already suggested (1911*b*, p. 265) that the *Doromasia picta* of Chun (1888, 1892) is not a monophyid, but perhaps identical with this species, and Moser (1911) definitely asserts that it is merely the young of *D. dispar*. The small specimens listed above agree very well with Chun's figure; the larger ones are broader; and specimens from the Philippines show that there is an increase in breadth with growth, though it is decidedly irregular.

DIPHYOPSIS CHAMISSONIS (Huxley).

Diphyes chamissonis HUXLEY, 1859, p. 36, pl. 1, fig. 3.

(For synonymy, see Bigelow, 1911*b*, p. 347.)

Station 4896, surface; 2 anterior nectophores, 8 and 9 mm. long.

Station 4955, surface; about 30 anterior nectophores.

Station 5064, 300–0 fathoms; 1 anterior nectophore.

I have also studied several specimens from the Philippines.

The species recently described by Lens and Van Riemsdijk (1908) as *Diphyopsis weberi* is undoubtedly the *D. chamissonis* of Huxley (Bigelow, 1911*b*, p. 244).

None of the present examples is in good enough condition to add anything to the previous accounts; but all of them show the five ridges at the apex, deep hydroecium reaching to the mid-level of the nectosac, short somatocyst, prominent dorso-basal and latero-basal teeth, and narrow form characteristic of the species. This is an appropriate place to point out that by some error in composition, overlooked in proof reading, the characterization of this species in my Key to the Diphyopsinae (1911*b*, p. 247) reads "somatocyst short, reaching only to the opening of the nectosac; hydroecium deep;" instead of "somatocyst short; hydroecium deep, reaching to the middle of the nectosac." As printed, the clause is obviously self-contradictory.

DIPHYOPSIS MITRA (Huxley) Bigelow.

Diphyes mitra HUXLEY, 1859, p. 36, pl. 1, fig. 4.

(For synonymy, see Bigelow, 1911*b*, p. 258.)

Station 4955, surface; 1 anterior nectophore.

Order PHYSOPHORAE.

Family FORSKALIIDAE Haeckel, 1888.

Genus FORSKALEA Kölliker, 1853.

FORSKALEA, species?

Station 4810, 100–0 fathoms; many fragments.

The material consists of parts of several specimens so contracted and fragmentary that nothing can be said about them further than that they belong to the genus *Forskalea*. At the locality of capture, off Cape Sirakimi, the surface temperature was 70°.

Digitized by Google

Family AGALMIDAE Brandt, 1835.

Genus AGALMA Eschscholtz, 1825.

AGALMA OKENI Eschscholtz.

Agalma okeni Eschscholtz, 1825, p. 744, pl. 5, fig. 17.

(For synonymy, see Bigelow, 1911*b*, p. 277.)

Station 4920, 300–0 fathoms; a large colony (50 mm. long) with 9 cormidia. The siphosome is in excellent condition; but the nectophores are all detached and loose in the bottle.

Station 4978; a fragmentary colony.

O-Shima Harbor; an example 30 mm. long, with 5 cormidia, in fair condition.

This widely distributed and easily recognized species has usually been known either as *Crystallomia polygonata* Dana or *Crystallodes vitreus* Haeckel. It has been described in detail by the latter author, by Lens and Van Riemsdijk (1908), and by me in a previous paper (1911*b*), where its relationship and history are discussed.

The outlines of the nectophores and bracts of this species are so characteristic that it is not likely to be confused with any other Agalmid, and the identity of the present series rests further on comparison with large series from the tropical Atlantic, tropical Pacific, and Philippine waters.

Family RHODALIIDAE, Haeckel, 1888.

Family RHODALIIDAE Bigelow, 1911*b*.

Genus ARCHANGELOPSIS Lens and Van Riemsdijk, 1908.

ARCHANGELOPSIS TYPICA Lens and Van Reimsdijk.

Plate 6, figure 7.

Archangelopsis typica Lens and Van Riemsdijk, 1908, p. 91, pl. 17, pl. 18, figs. 137–140.—Bigelow, 1911*b*, p. 350.

Station 4903, 139–0 fathoms; 1 specimen, in good condition except that all the nectophores but the youngest have been detached.

I mentioned this specimen in my report on Eastern Pacific Siphonophores (1911*b*, p. 303), but it came to hand too late for me to give an account of it in that work.

Lens and Van Riemsdijk (1908) have given a good account of the general anatomy of this interesting genus, particularly of the aurophore, but as their specimens were all more or less fragmentary, especially with regard to the cormidia, a description of the present example will not be amiss.

The general structure of the specimen, with large pneumatophore, nectosome with longitudinal muscular lamellæ which bore the nectophores in life, and siphosome in the form of a thin-walled bag, agrees

Digitized by Google

with the original account. The pneumatophore is about 9 mm. long. The aurophore is covered with papilliform appendages (pl. 6, fig. 7), and closely resembles the corresponding organ of *Dromalia* (1911*b*, pl. 23, fig. 7) in external appearance; the serial sections studied by Lens and Van Riemsdijk (1908) show that in its internal anatomy it differs, though not essentially, from that genus.

The present example was not sectioned, partly because it was not in very good histological condition, partly because it was desirable to preserve it intact, but optical sections of the appendages of the aurophore, cleared in glycerine, show that each has a terminal pore, as in *Dromalia*. The older nectophores were all detached, and there were none in the bottle, but one very young one is still in place.

The zone of proliferation, as in *Dromalia* and *Angelopsis*, lies directly opposite the aurophore on the nectosome close to its junction with the pneumatophore (pl. 6, fig. 7). Unfortunately, this region is damaged, there being only one young nectophore, and two young siphons with their tentacles, so that it is impossible to work out the successive stages in the growth of the various appendages, as I was able to do in *Dromalia* (1911*b*). On the opposite side of the nectosome, just below the aurophore, there is a naked zone, just as in *Dromalia*.

Cormidia.—The basal surface of the siphosome is covered with cormidia. In my preliminary reference to this specimen (1911*b*, p. 308) I said that they were apparently arranged in a spiral, as they certainly are in *Dromalia*. But a more careful examination shows that they are so crowded, owing to the contraction of the siphosome as a whole, that it is impossible to make sure whether the arrangement is fundamentally spiral or not. In their present condition they are all closely in contact with one another.

The cormidia themselves resemble those of *Dromalia* (1911*b*, pl. 23, fig 9) in structure. The appendages of each group, as in that genus, are situated on a stout gelatinous stalk, considerably longer in *Archangelopsis* than in *Dromalia*, which is traversed by a canal putting the siphons and gonophores in connection with the general vascular system of the siphosome (that is, the hypocystic cavity).

Each cormidium consists of siphon with its tentacle, and usually two gonodendra which are variously branched. In one case, however, there are four separate gonodendra, each with its own independent stalk. Unfortunately most of the older gonophores are lost, but the few large enough to show their sex are all males, which suggests, though it does not prove, that all the gonophores of a given example are of one sex, as Brooks and Conklin (1891) found them in the specimen of *Rhodalia* (?) studied by them. In *Dromalia* this point could not be determined. In *Rhodalia* Haeckel (1888) describes both male and female gonophores for a single specimen.

Digitized by Google

Each gonodendron bears several long thin-walled palpons in addition to the gonophores.

In their present condition all the cormidia have dropped their siphons, but the scar left by this mutilation is invariably very noticeable just proximal to the point at which the gonodendra branch out. The one siphon loose in the bottle is of the usual type, but its tentacle, as Lens and Van Riemsdijk observed, is unusually stout, and it has a well-developed suspensional membrane as in *Dromalia*. The only tentilla intact are so young that they as yet give no indication whether an involucre is formed later, or how many terminal filaments they are fated to have.

In many cases the gelatinous stalks bear accessory stalks near their bases, and these accessory stalks develop gonophores and palpons. But I have found none with a siphon, and am in doubt whether any of them normally bore such organs.

One of the most interesting features of the specimen remains to be mentioned; this is that the stalks of the cormidia near the upper end of the bag-like siphosome usually bear from one to three small wing-like muscular lamellae on their outer sides, close to the base. At present there is nothing attached to any of these lamellae, but they are reminiscent, both in structure and in position, of the lamellae to which the bracts are attached in various Agalmids, as, for instance, *Stephanomia bijuga* (1911*b*, pl. 20, fig. 1), and therefore suggest the possibility that *Archangelopsis* may have bracts as well as nectophores.

Suborder CHONDROPHORAE.

Family PORPITIDAE Brandt, 1835.

Genus PORPITA Lamarck, 1801.

PORPITA PACIFICA Lesson.

Porpita pacifica LESSON, 1826, pl. 7, figs. 3, 3′.

(For synonymy, see Bigelow, 1911*b*, p. 333.)

Station 4883, surface; 7 specimens, 23 to 40 mm. in diameter.
Station 4884, surface; 4 specimens, 30 to 35 mm. in diameter.
Station 4909, surface; 2 specimens, 25 and 30 mm. in diameter.
Station 4917, surface; 1 specimen, 2 mm. in diameter.
Station 4921, surface; 49 specimens, 1.5 to 9 mm. in diameter.
Station 4952, surface; 3 specimens, 4 to 11 mm. in diameter.

The specimens, all from Japanese waters, are interesting chiefly because they supplement the rather large examples collected by the Fisheries steamer *Albatross* in the eastern Pacific (1911*b*, p. 333). The characters which separate *pacifica* from all specimens of the Atlantic *umbella* yet described, and all the ones which I have studied, are the tubercles on the superior surface of the disk, the greater num-

Digitized by Google

ber of stalked nematocyst knobs on the tentacles, the more complexly branched limbar canals, and the fewer open stigmata.

In the eastern Pacific specimens 50–55 mm. in diameter, the tubercles were extremely prominent and covered all the upper surface of the disk except a narrow marginal ring (1911*b*, pl. 28, fig. 1). In the present specimens of 25–40 mm. they are smaller and restricted to the central part of the disk. But the fact that in one of 28 mm. the region which they cover is only as broad as half the radius of the disk, whereas in one of 35 mm. it is as broad as the radius, shows that they extend farther and farther toward the margin with growth, a later stage in this process being illustrated by the large specimens from the eastern Pacific. Specimens of 11 mm. or less have no tubercles, and there is a gap in the series between them and those of 23 mm.

The number of tentacular nematocysts in each row, in five tentacles taken at random from three specimens, is: 25 mm. in diameter—30, 19, 19; 27, 19, 19; 29, 19, 19; 31, 19, 19; 31, 18, 19; 31, 17, 16; 30 mm. in diameter—25, 15, 16; 30, 19, 18; 27, 15, 16; 26, 18, 18; 27, 16, 17; 40 mm. in diameter—32, 16, 16; 29, 14, 15; 34, 15, 15; 30, 17, 16; 31, 17, 16.

At first sight it seems surprising that the smallest specimens should have more knobs than the next larger one, but it has a goose-barnacle parasitic upon it, and is perhaps stunted in consequence. The numbers in all three are rather larger than in the eastern Pacific specimens, in which they were from 25–29 in each of the long and 11–14 in each of the short rows.

Umbella has been described as having 9–12 in the long, 6–8 in the short rows (A. Agassiz, 1883; Chun, 1897*b*). In two specimens the numbers are: 22 mm. in diameter, Naples—12, 6, 7; 11, 6, 6; 12, 7, 7; 10, 6, 6; 11, 5, 6; 26 mm. in diameter, Tortugas—13, 9, 7; 11, 6, 7; 15, 7, 8; 11, 9, 9; 12, 6, 8. Unfortunately, I have no large specimens with the tentacles intact.

The limbar canals in the Japanese specimens agree very well with the conditions in the eastern Pacific series (1911*b*), being very much branched and irregular, and the limbus itself is narrower than in any *umbella* which I have seen, though it would take a large series of each to show whether this difference is really important. In the specimens of *pacifica* upward of 25 mm. in diameter there are no open stigmata in the central region, but in the peripheral parts of the disk the stigmata are rather more numerous than in the corresponding region in large eastern Pacific examples, from which it appears that they are successively closed as growth progresses. In *umbella* many more are permanently open (1911*b*). The very small specimens 1.5–2 mm. broad are all further advanced than the larva which I have already described, though no larger, for all of them have more than eight gastrozooids, and the velum is already noticeable in all.

Digitized by Google

Class SCYPHOMEDUSAE.

Order CORONATA.

Family PERIPHYLLIDAE Haeckel, 1880.

Genus PERIPHYLLA Steenstrup, 1837.

For accounts of the anatomy and histology of this genus, see Haeckel (1881), Maas (1897, 1903, 1904*b*), and Vanhöffen (1902*a*).

The present collection contains a large and excellently preserved series of typical *P. hyacinthina*, ranging from very young, in which the gonads have not appeared, to an example 70 mm. in diameter, thus affording a good opportunity to trace the development of the endodermic pigment. This is of interest because this character is used by Maas (1904*b*) and by Vanhöffen (1902*a*) to separate *hyacinthina* from *dodecabostrycha*, the former, according to their diagnoses, being so densely pigmented over the entire subumbrella that the gonads are invisible from without, the latter having the pigment limited to the gastric cavity and upper part of the subumbrella, allowing the gonads to show through. In my account of the eastern Pacific medusae (1909*a*) I gave a survey of the published evidence on this question, and pointed out that the specimens so far described with the *dodecabostrycha* pigmentation were all rather small; but this statement needs correction because Vanhöffen has called my attention to the fact that I overlooked a *dodecabostrycha* 56 mm. broad described by him, and which, as he writes me, had no trace of pigment in the ring-sinus. It appears from this that the *dodecabostrycha* condition is not necessarily transitory, though the present series shows that specimens which assume the *hyacinthina* pigmentation when adult pass through a *dodecabostrycha* stage. And it also shows that in the adult there is a good deal of variation in the density of the pigmentation of the peripheral regions. This suggests, of course, that there is no sharp line between *hyacinthina* and *dodecabostrycha;* that if the two are distinguishable at all they are at most varieties of one species. But to settle the relationship of the two will require more data than is available at present. We need, especially, series of growth stages of the *dodecabostrycha* type, and large series of the adults of both, to show whether or not intermediates occur. Without this information further speculation can not lead to any definite result.

The status of *P. regina* is also unsettled. Like *hyacinthina* it is so densely pigmented that the gonads are concealed; and it is separated from that species only by large size and perhaps by a brighter red color. I have not been able to study any good material of this form, so do not feel qualified to express a definite opinion.

Digitized by Google

PERIPHYLLA HYACINTHINA Steenstrup.

Periphylla hyacinthina STEENSTRUP, 1837.

(For full synonymy, see Bigelow, 1909*a*, p. 26, and Mayer, 1910, p. 544.)

Station 4758, 300–0 fathoms, south of Alaska Peninsula; 2 specimens.

Station 4759, 300–0 fathoms, south of Alaska Peninsula; 3 specimens.

Station 4760, 300–0 fathoms, south of Alaska Peninsula; 2 specimens.

Station 4761, 1973–0 fathoms, south of Alaska Peninsula; 1 specimen.

Station 4765, 1217–0 fathoms; 1 specimen.

Station 4766, 300–0 fathoms, Bering Sea; 4 specimens.

Station 4767, 300–0 fathoms, Bering Sea; 4 specimens.

Station 4773, 334–0 fathoms, Bering Sea; 3 specimens.

Station 4774, 557–0 fathoms, Bering Sea; 2 specimens.

Station 4775, 585–0 fathoms, Bering Sea; 3 specimens.

Station 4781, 482–0 fathoms, Bering Sea; 1 specimen.

Station 4785, 300–0 fathoms, Bering Sea; 7 specimens.

Station 4793, 300–0 fathoms, off Kamchatka; 2 specimens.

Station 4797, 300–0 fathoms, Sea of Okhotsk; 2 specimens.

Station 4928, 1008–0 fathoms, Japanese waters; 1 specimen.

Station 4951, 703–0 fathoms, Japanese waters; 1 specimen.

Station 4956, 720–0 fathoms, Japanese waters; 1 specimen.

Station 4958, 405–0 fathoms, Japanese waters; 1 specimen.

Station 5063, 300–0 fathoms, Japanese waters; 1 specimen.

Also—

Station 3070, 685–0 fathoms, off the coast of Oregon; 3 specimens.

Station 3222, 50–0 fathoms, Bering Sea; 1 specimen.

Out of the total of 46 specimens, 29, illustrating the whole range of development from 10 to 70 mm. in diameter, are in beautiful condition; the remainder may be described as fair.

From the systematic standpoint the most important thing illustrated by this series is the extension of the entodermal pigmentation with growth. In the specimens up to about 15 mm. in diameter the pigment is entirely restricted to the stomach, as in the young specimens from the eastern Pacific. The gonads are first visible in a specimen of about 10 mm; and in the examples of 12–15 mm., they are of considerable size; so these specimens, if captured alone, would probably have been recorded as *dodecabostrycha*. As growth proceeds, the pigmentation extends from the stomach out over the subumbrella. The beginning of the process is to be seen in a specimen of 16 mm., and in those of 20 mm. the pigment is fairly dense as far as the proximal ends of the gonads in the radii of these organs, while between them it reaches to about the middle of their length, corresponding to the corner of the stomach.

Digitized by Google

In a slightly older specimen, 23 mm. in diameter, the ring sinus, lappet canals, and the surface of the gonads themselves are faintly reddish; in other words, the pigmentation has now attained practically its final extent, though in the distal regions it is still so faint that the gonads are visible from without.

Though all the large specimens are so heavily and extensively pigmented that their identity, as *hyacinthina*, is at once apparent, it is not correct to say that the gonads are always rendered invisible from without by the pigment. This may be the case; for example, in two perfect specimens about 25 and 45 mm. in diameter they are entirely hidden. But in another of 40 mm. in equally good condition the gonads show plainly from without, the pigment in this case being less dense, though equally extensive. Again, in a much smaller specimen (27 mm.), they are entirely hidden; in one of 36 mm. their distal ends plainly visible, though the pigment has attained its final extent. These irregularities show that there is considerable individual variation in the density of the pigment, though in all large specimens it extends over the ring sinus and peripheral canal system.

General form, another character which has been supposed to separate *hyacinthina* from *dodecabostrycha*, but in which, as I have pointed out (1909*a*), no sharp division line can be drawn, likewise shows much individual variation. The very small specimens are all low and broad, the medium-sized ones proportionately higher, usually with the pointed outlines, with pronounced "stiel canal." But there is much variation, the extremes being a specimen 40 mm. in diameter and 50 mm. high; that is, with proportions in terms of the diameter, of 1.25 : 1, and one 40 mm. high and 40 mm. in diameter. None of these specimens are proportionately so high as some previously recorded; for example, Vanhöffen mentions examples of 1.9 : 1, and 1.7 : 1 (Bigelow, 1909*a*, p. 25).

The form of the upper part of the gastric cavity, whether rounded or conical, seems to be largely a question of contraction. In the best specimens, which, to judge from their condition, must have been alive when put into the preservative, it is of the latter, in the more damaged ones, of the former type. And *hyacinthina* with low, rounded stomach has already been recorded (1909*a*; Vanhöffen, 1902*a*).

Family NAUSITHOIDAE Bigelow.

Family EPHYROPSIDAE[1] Claus.

Genus NAUSITHOË Kölliker, 1853.

NAUSITHOË PUNCTATA Kölliker.

Nausithoe punctata Kölliker, 1853*a*, p. 323.

(For synonymy, see Bigelow, 1909*a*, p. 35; Mayer, 1910, p. 554.)

Station 4927, surface; 2 specimens, 12 mm. in diameter.

[1] Untenable, because *Ephyropsis* Claus is a synonym of *Nausithoë* Kölliker.

Digitized by Google

Family ATOLLIDAE Bigelow.

Family COLLASPIDAE[1] Haeckel.

Genus ATOLLA Haeckel, 1880.

The general anatomy of this peculiar genus is now well known, thanks to Maas (1897, 1903, 1904*b*) and Vanhöffen (1902*a*); but the specific relationships of its members are still unsettled, because the characters which have been used to separate the various closely allied "species," are all more or less subject to individual variation.

The characters used by Vanhöffen to separate species are the presence or absence of radial furrows in the central disk; whether the furrows, if present, are broad or narrow; the presence or absence of exumbral warts; and the size of the septal nodes. But I have found that it is impossible to draw any sharp line between specimens with broad and those with narrow radial furrows; and the present series shows that the size of the septal nodes is so variable that it can not be a specific character. There remain then only the presence or absence of radial furrows, and of exumbral knobs. Mayer notes that the former is not a sharp difference, because there may be faint sinuosities on the margin of the central disk, without any true radial furrows; so that he suggests that the two forms, *wyvillei* with furrows and *bairdii* with a smooth disk may be merely varieties of a single species.

Vanhöffen recognized five species, *bairdii*, *valdiviae*, *verrillii*, *chuni*, and *wyvillei;* but Mayer reduces these to three, *bairdii* with smooth disk, *wyvillei* with radial furrows, and *chuni*, in which the lappets are sprinkled with exumbral papillae; a reduction which seems warranted. *Chuni* has now been recorded by Browne (1910) from the Antarctic, and Hartlaub (1909*a*) has recently described another species, *A. tenilla* from the Greenland Sea; but this is probably the young either of *bairdii* or of *wyvillei*.

ATOLLA WYVILLEI Haeckel.

Atolla wyvillei Haeckel, 1880, p. 488; 1881, p. 113, pl. 29, fig. 1–9.—Vanhöffen, 1902*a*, p. 13, pl. 5, fig. 22.—Bigelow, 1909*a*, p. 39, pl. 8, fig. 1; pl. 9, fig. 3; pl. 10, figs. 8, 9.
Collaspis achilis Haeckel, 1880, p. 489.
Atolla alexandri Maas, 1897, p. 81, pl. 11, fig. 2; pl. 14, fig. 4, 5.
(For full synonymy see Mayer, 1910, p. 566.)

Station 4758, 300–0 fathoms; 1 specimen.
Station 4759, 300–0 fathoms; 2 specimens.
Station 4760, 300–0 fathoms; 3 specimens.
Station 4764, 1130–0 fathoms; 1 specimen.
Station 4765, 300–0 fathoms; 1 specimen.

[1] Untenable, because *Collaspis* is a synonym of *Atolla*.

Digitized by Google

Station 4766, 300–0 fathoms; 7 specimens.
Station 4767, 300–0 fathoms; 4 specimens.
Station 4773, 300–0 fathoms; 2 specimens.
Station 4780, 1046–0 fathoms; 1 specimen.
Station 4917, 361–0 fathoms; 1 specimen.
Station 5058, 300–0 fathoms; 3 specimens.
Station 5063, 300–0 fathoms; 2 specimens.
Station 5064, 300–0 fathoms; 3 specimens.
Station 5079, 300–0 fathoms· 1 specimen.
Also—
Station 3009, Gulf of California, 857–0 fathoms; 2 specimens.
Station 3070, off the coast of Oregon; 636–0 fathoms; 1 specimen.
Station 3071, off the coast of Oregon, 685–0 fathoms; 2 specimens.

These specimens are all in such good condition that it is easy to see that they belong to *wyvillei;* but 22 damaged Atollas, taken at stations 4767, 4774, 4906, 4907, 4908, 4909, 4917, 4919, 4957, 5063, in the trawl, show no furrows clearly; though judging from their general condition it is probable that the absence is due to rubbing in the net.

Several of the undoubted *wyvillei* are in beautiful condition.

In the eastern Pacific specimens there was considerable variation in the breadth of the furrows, which were usually broad in large, narrow in small, specimens. And in a general way the same is true of the present series. But the furrows vary so much in the large specimens, and ever in a given specimen, that no sharp line can be drawn between specimens in which they are broad and those in which they are narrow.

The size of the septal nodes has been used as the chief distinguishing character between *valdiviae* and *bairdii* (Vanhöffen, 1902*a*); and it is therefore interesting that these organs vary in size and proportions in the present series. Thus in a specimen 70 mm. in diameter the nodes are 9 mm. long and 5 mm. broad, while in another of about the same size (71 mm.), they are 12 mm. long by 3 mm. broad; that is, proportionately only about half as broad in the latter as in the former. In other examples intermediates are to be seen. In *valdiviae,* according to Vanhöffen's figure (1902*a*, pl. 6, fig. 41), the septal nodes are about two-thirds as broad as long; that is, only slightly broader than in our 70 mm. specimen.

A new character was described for *bairdii* by Maas (1904*b*), namely, the occurrence of septal regions subdividing the tentacular canals, and in many of our specimens there are clear oval regions in the tentacular canals which look like septa. But it is easy to demonstrate that there is no discontinuity in the cavity; and the copepods which are so often seen in the canals are as apt to lie in these false septa

Digitized by Google

as anywhere else. The true explanation of these clear spaces is afforded by the fact that the dense entodermal pigmentation of the aboral surfaces of the canal walls is lacking in the clear spaces. When the pigmented ectoderm of the subumbrella is rubbed off the spaces are noticeable; and this has happened more or less in most of the specimens, even when they are otherwise in excellent condition. There is one specimen in which the subumbrella pigment is intact, and in this one the false septa are only very faintly visible.

The general structure of the peripheral canal system has been described by Vanhöffen (1902*a*) for *valdiviae*, by Maas (1904*b*) for *bairdii* and by me (1909*a*) for *wyvillei*.

Order DISCOPHORA.

Suborder SEMAEOSTOMATA.

Family PELAGIDAE Gegenbaur, 1856.

Genus PELAGIA Péron and Lesueur.

The revision of this genus would be of great value to the zoogeographer as well as to students of pelagic coelenterates; but it must be postponed until some one has access to large series from all oceans. For the present, the chief duty of any one who can examine a small series of Pelagias is to give the details of the two characters which, according to Maas (1903) and Mayer (1910) separate the "species," i. e., proportions of manubrium and mouth arms, and form of the exumbral nettle knobs.

The specimens in the collection agree very well with the eastern Pacific examples, with the *Siboga* material described by Maas (1903), with the *Valdivia* collection which Vanhöffen described as *P. phosphora*, and with specimens from the Hawaiian Islands, the Philippines, and from Australia. I have given elsewhere (1909*a*) the reasons for the choice of the name *panopyra* Péron and Lesueur for this form.

PELAGIA PANOPYRA (Péron and Lesueur).

Medusa panopyra PÉRON and LESUEUR, 1807, pl. 31, fig. 2.

(For synonymy, see Bigelow, 1909*a*, p. 43.)

Station 4910, surface; 1 specimen.
Station 4920, surface; 7 specimens.
Station 4921, surface; about 15 specimens.
Station 4926, 165 fathoms; 1 specimen.
Station 4932, surface; 25 specimens.
Station 4950, surface; 1 specimen.
Station 4952, surface; 15 specimens.
Station 4954, 850–0 fathoms; 3 specimens.

Digitized by Google

Station 4970, 300–0 fathoms; 4 specimens.

Station 5079, surface; 7 specimens.

Station 5081, surface; 1 specimen.

The localities are all in Japanese waters with surface temperatures of 75°–86° F.

Measurements of 10 specimens, 21–60 mm. in diameter, are:

Diameter.	Length of manubrium.	Length of mouth arms.
21	9	27
25	15	23
30	15	31
36	14	50
40	25	31
42	16	38
50	22	74
50	21	60
56	20	90
60	23	97

These measurements show that there is a good deal of variation in the proportional lengths of manubrium and mouth arms, so much so that it is doubtful whether Maas's (1903) suggestion that *panopyra* and *perla* are separated by great length of the manubrium in the former, its almost entire suppression in the latter, is justified. The present series as a whole seems to have a rather longer manubrium than the specimens recorded by Vanhöffen, in which it ranged from 5–25 mm. in specimens 18–54 mm. in diameter. But in deciding how much weight this difference deserves, I may point out that this particular measurement is not a reliable one, because it depends very largely on whether the manubrium is extended or contracted; and also on whether it is stretched when the measurement is taken. To make the measurements of the present series comparable with one another, they were taken with the manubrium and mouth arms stretched out straight.

The shape of the exumbral nettle knobs is the main feature employed by Mayer for specific diagnosis, but as Vanhöffen (1902*a*) has pointed out, the types intergrade. In the first place there is not a single specimen, nor have I ever seen one, in which the knobs are all alike; but in every one round knobs, oval ones, linear or sausage-shaped ones, and linear ones subdivided by transverse furrows are to be seen. In specimens from Australia and from Naples the same variety occurs; but in the three large specimens of the Mediterranean form, "*noctiluca*," which I have studied, long narrow knobs largely predominate, whereas in the present series the various types are more equally represented. In our small specimens 14–20 mm. in diameter most of the knobs are round or oval, and they are much higher proportionately than in the larger ones. This suggests that the

Digitized by Google

large ridge-like knobs are characteristic of advanced stages in growth, which would explain their predominance in the large Mediterranean examples.

Color.—In the large specimens, as in those from the eastern Pacific (1909*a*), gonads, tentacles, subumbrella, and the four perradial ridges of the mouth arms are pink-violet, varying in strength in different specimens. Some are almost colorless, but these are poorly preserved. The small ones are colorless except that the manubrium and gonads are pinkish, or, in some, pale yellowish.

Mayer separates *P. flaveola* Eschscholtz (including *P. tahitiana* Agassiz and Mayer) on account of its yellow color, but Vanhöffen (1902*a*) found that color changes with growth from yellowish to violet.

Genus SANDERIA Götte.

SANDERIA MALAYENSIS Götte.

Sanderia malayensis Götte, 1886, p. 835.—Vanhöffen, 1902*a*, p. 38, pl. 3, fig. 12; pl. 8, fig. 69–74.—Mayer, 1910, p. 590, fig. 375.
Neopelagia eximia Kishinouye, 1910, p. 14, pl. 3, fig. 15.

Station 4841, surface, Sea of Japan; 1 specimen.
Station 4845, surface, Sea of Japan; 1 specimen.
Station 4921, surface, off Kagoshima Bay, Japan; 1 specimen.
The temperatures at these stations range from 76° to 84°.
The specimens range from 40 mm. to about 70 mm. in diameter.

Such good accounts of *S. malayensis* have been given by Vanhöffen (1902*a*) and Mayer (1910) that it is not necessary to describe it in detail here. The large specimen agrees with Vanhöffen's excellent figures of the species, except that the gonads are more advanced, and the smaller ones differ from it only in the more primitive state of development of the gonads and tentacles.

Genus CHRYSAORA Péron and Lesueur.

The collection contains a single large *Chrysaora* which is probably the *C. melanaster* of Brandt, but it has lost its mouth parts and most of the margin, besides being otherwise so badly damaged that its identity is not certain.

? CHRYSAORA MELANASTER Brandt.

Chrysaora melanaster Brandt, 1838, p. 385, pl. 16, 17.

(For synonymy, see Mayer, 1910, p. 582.)

Station 4781, 300–0 fathoms; 1 fragmentary specimen, 130 mm. in diameter.

Genus DACTYLOMETRA L. Agassiz.

This genus has usually been defined as having five tentacles to the octant (as for example, by Vanhöffen, 1902*a*, Maas, 1909, Mayer, 1910,

Digitized by Google

p. 583), but Mayer (1910) has already pointed out that the number of tentacles to the octant in the type species *lactea* L. Agassiz may be more than five, and in a considerable number of *lactea*, and as the following table shows, it is the rule, not the exception, to find more than five tentacles to the octant.

Dactylometra lactea, Santiago, Cuba.

Diameter, mm.	Tentacles per octant.	Total tentacles.
26	5, 5, 5, 4, 4, 5, 5, 4	37
31	4, 4, 3, 3, 3, 3, 4, 3	27
38	5, 5, 5, 6, 6, 5, 6, 6	44
39	3, 5, 4, 4, 5, 5, 4, 3	33
48	8, 7, 6, 6, 8, 7, 7, 8	57
55	6, 5, 6, 4, 6, 7, 6, 7	47
58	7, 7, 7, 7, 8, 6, 8, 6	56
62	6, 7, 5, 6, 5, 6, 5, 5	45
66	7, 7, 8, 7, 6, 7, 7, 6	55
79	9, 7, 7, 8, 7, 9, 8, 7	62

On examining the individual octants it was at once evident that when there were only five tentacles, the ones nearest the ocular lobes were usually the youngest; but when there were more, the others were irregularly interpolated. This, of course, shows that it is impossible to distinguish *Kuragea* with seven, from *Dactylometra* with five tentacles to the octant; and as we do not yet know what the limit to tentacle formation is in *D. lactea*, we may define *Dactylometra* as Pelagidae with five or more tentacles to the octant.

The various species of *Dactylometra* are distinguished from one another only by such minor characters as color, number of tentacles, and form of the marginal lappets, features all more or less variable. The Pacific forms, *ferruginaster* Kishinouye and *pacifica* Götte, are undoubtedly merely successive stages in the development of one species (Maas, 1909), in which, as the present collection shows, five tentacles per octant are attained in specimens of about 40 mm. in diameter. In large specimens of this species accessory tentacles appear (*D. longicirrha* Kishinouye), and in its final condition there are seven tentacles per octant (*Kuragea depressa* Kishinouye).

According to Kishinouye, the tentacles are short in *ferruginaster*, long in *pacifica* (=*longicirrha* Kishinouye), but my series of *lactea* and the Japanese Dactylometras in the present collection show that there is too much variability in this respect and that it is too subject to contraction to be used in classification. *D. africana* Vanhöffen, which has five tentacles per octant when very large, seems to be allied to *quinquecirrha*, in which there are never more than five, often less; indeed, the only thing definitely separating it from the latter is its brilliant coloration. For an excellent survey of the genus and of the variation of *D. quinquecirrha*, see Mayer (1910).

Digitized by Google

DACTYLOMETRA PACIFICA Götte.

Dactylometra quinquecirrha, var. *pacifica* GÖTTE, 1886, p. 834.
Dactylometra ferruginaster KISHINOUYE, 1892, p. 264, pl. 3.—MAYER, 1910, p. 588.
Dactylometra longicirrha KISHINOUYE, 1892, p. 261, pl. 2.
Kuragea depressa KISHINOUYE, 1902, p. 9, pl. 1, fig. 7.
Dactylometra pacifica, var. *ferruginaster* MAAS, 1909, p. 44, pl. 2, fig. 14.

Tsuruga Gulf, Japan, surface, July 23; six specimens, 38–81 mm. in diameter; in good condition.

The smallest specimen has 4, 4, 5, 5, 5, 5, 3, and 4 tentacles in the eight octants; all others have five in each octant; the central are often, but not always, the largest, the two on either side slightly smaller, i. e., younger. In Maas's specimens (40 and 90 mm.) the lappets next the rhopalar lappets were the smallest (Maas, 1909, pl. 2, fig. 14); and this is true of our smallest specimen. But in the large ones the tentacular lappets are all about the same size, though distinctly smaller than the rhopalar lappets.

The rhopalia resemble those of *quinquecirrha* so closely that I can find nothing to separate them.

Color.—In the largest specimen the reddish-brown exumbral star, which suggested the name *ferruginaster*, is faintly visible; the others have lost their color in the preservative.

Family CYANEIDAE L. Agassiz, 1862.

Genus CYANEA Péron and Lesueur, 1809.

At present it seems impossible to distinguish more than one species in this genus, for although several forms have been described which are so unlike, especially in color, as to be recognizable at a glance, they are all connected by intermediates. A revision of the Cyaneas, with a study of their exact geographic ranges is much to be desired; but to be of value it will require a much larger series of well-preserved material than I have at my command. Mayer (1910, p. 597) has given an excellent synopsis of the various varieties.

The present collection contains two forms; one from the Bering Sea, apparently identical with *C. ferruginea* of Eschscholtz; probably also with the *C. postelsii* of Brandt. Comparison between it and a "*lamarckii*" from the North Sea and an "*arctica*" from New England, shows that it agrees with the former, and with the figures of "*capillata*" (Vanhöffen), in the size and shape of the rhopalar lappets, with the latter in yellowish color, and in the arrangement of the lappet canals.

It is so doubtful whether there is anything to distinguish the var. "*ferruginea*" from *capillata* that the specimens are referred to the latter.

The second form, from southern Japan, is undoubtedly the *C. nozakii* of Kishinouye (1891). It is distinguished by the entire lack of color,

Digitized by Google

by the fact that the rhopalar lappets are scarcely marked off, by the structure of the rhopalia, and by the structure of the circular musculature of the subumbrella, which is separated into 16 blocks by broad gelatinous ridges, a condition different from that in *capillata*, *arctica*, and *lamarckii*, where the 16 muscular trapezia are separated from one another by very narrow gaps, if at all. But the two extremes are not discontinuous, for in specimens from Puget Sound and from Sakhalin Island the outer part of the circular musculature is broken by 16 gaps of medium breadth, though the inner part is continuous all around its circumference.

CYANEA CAPILLATA, var. CAPILLATA (Linnaeus) Eschscholtz.

Plate 4, figs. 8, 9.

Medusa capillata LINNAEUS, 1758, vol. 1, p. 660.

(For synonymy and synopsis of varieties, see Mayer, 1910, pp. 596, 597.)

Dutch Harbor, May 26, surface; 3 medium-sized specimens, 75, 120, 170 mm. in diameter; 7 small ones, 22–40 mm.

Station 5005, surface; 1 specimen, 70 mm.; disk only.

Station 5024, surface; 1 specimen, 160 mm.

CYANEA CAPILLATA, var. NOZAKII Kishinouye.

Plate 4, figs. 5–7.

Cyanea nozakii KISHINOUYE, 1891, p. 1, pl. 1.

Kobe, Japan, August 24, surface; 1 specimen of about 150 mm.; in excellent condition.

This specimen is particularly interesting, as showing how much *nozakii* differs from *capillata* in its extreme type. As pointed out above, the characters of importance in this respect are the form of the marginal lappets, the structure of the musculature and the color. The interrhopalar notches are not so deep as the rhopalar, and the margin follows an uninterrupted curve, between the two, so that there are no distinct rhopalar lappets.

The subumbrella musculature consists of series of radial and circular bands (pl. 4, fig. 5), the latter broken into 16 groups separated by broad, rounded gelatinous ridges, the interrhopalar groups being about twice as long as the rhopalar. And they differ from those of *capillata* not only in this respect but also in the fact that the individual muscle bands are fewer in number (only 9–10 in each group instead of 15–20), and much stouter.

The rhopalia, likewise, separate *nozakii* (pl. 4, fig. 6) from *capillata* (pl. 4, fig. 9), for in the former they lack the rounded prominences on the subumbral side near the base, which are prominent features in the latter.

The specimen is colorless.

Digitized by Google

CYANEA, variety?

Station 5008, near Sakhalin Island, surface; 1 fragmentary specimen, 140 mm. in diameter.

This specimen has lost part of the margin, and all the tentacles and mouth-arms, but what remains shows that it was almost exactly intermediate between var. *capillata* and var. *nozakii*. The sense organs agree with those of the latter; the rhopalar lappets are marked off by very shallow notches, that is, they are intermediate, and the circular musculature is especially instructive, as the 9 or 10 outer bands are separated into 16 groups by broad spaces, while the 4 or 5 inner ones are unbroken, and it is interesting that it is intermediate in geographic occurrence, as well as anatomically.

Family AURELIIDAE L. Agassiz, 1862.

Family ULMARIDAE[1] Haeckel (1879).

Genus PARUMBROSA Kishinouye, 1910.

Aureliidae with 8 sense organs; with 24 tentacles; with blind canals extending from the ring canal outward into the marginal lappets.

Parumbrosa is closely allied to *Discomedusa* and *Undosa;* but it differs from the type species of both of these in the occurrence of blind branches from the ring canal into the marginal lappets, such as are present in *Phacellophora*. Mayer (1910) does not consider this character of generic importance, but separates *Parumbrosa* from *Discomedusa* solely on the ground that there are twice as many marginal lappets, i. e., two instead of one, between every two marginal organs (that is, tentacles or rhopalia). In the present case it seems clear that the number of lappets has less phylogenetic meaning than the presence of canals, because, as Mayer himself points out, the two lappets between every two tentacles of *Parumbrosa polylobata* are merely the result of the fission of single lappets.

The features separating *Parumbrosa philippina* Mayer from *P. polylobata* are that in the former there is only one lappet between every two canals, and that the branching and anastomosis of the per- and interradial canals is rather more complex than Kishinouye (1910) represents it for the latter.

PARUMBROSA POLYLOBATA Kishinouye.

Parumbrosa polylobata KISHINOUYE, 1910, p. 19, pl. 4, fig. 20–23.

Station 4898, 207–0 fathoms; 1 specimen, 65 mm. in diameter.

Station 4899, 207–0 fathoms; 1 specimen, 110 mm. in diameter, and fragments of another.

Both of these stations are off the Goto Islands.

The specimens have both lost most of their mouth parts and are otherwise damaged, but fortunately they still show the canal system,

[1] Untenable, because *Ulmaris* Haeckel is a synonym of *Discomedusa* Claus.

Digitized by Google

the marginal lappets, tentacles and rhopalia, and the gonads, so clearly that there is no doubt of their identity with *P. polylobata*. Kishinouye (1910) has given a good account of the species (summarized by Mayer, 1910).

In our smaller specimen the canal system is in about the same stage as in Kishinouye's figure, except that one of the adradial canals anastomoses near its distal end with the perradial on one side, the other adradials being unbranched. But in the large one the branching and anastomosis of the per- and interradials is considerably more complex than he shows it, though less so than it is in *philippina* (Mayer, 1910). No two octants, however, are exactly alike. In this specimen all of the adradials anastomose more or less with the neighboring per- and interradials near their outer ends, though the exact conditions vary from octant to octant, just as in *Discomedusa lobata* Claus. The margin, with its narrow lanceolate lappets, agrees very well with Kishinouye's figure, except that he does not show the eight otocysts, though their positions are indicated.

Kishinouye's specimens were taken in Toyama Bay, and according to the local fishermen it is never found on the surface.

Genus PHACELLOPHORA Brandt, 1838.

An excellent account of the general structure of this genus has been given by Mayer (1910), but it is so far known from so few specimens that it is difficult to decide how much importance should be attached to the supposed distinctions between its four members, *camtschatica* Brandt, *ambigua* Brandt, *ornata* Verrill, and *sicula* Haeckel. The only tangible differences between them are afforded by the degree of scalloping or subdivision of the marginal lappets, for although a considerable range has been recorded for the number of tentacles and canals, this is subject to individual variation, as well as to progressive changes with growth.

In *P. camtschatica*, which is necessarily the type species of the genus, each of the tentacular lappets is cleft into seven, and the sense organ is apparently covered by a large projecting scale, flanked on either hand by a narrow lappet, the three together making a tridentate organ. In *ambigua* each tentacular lappet is divided into two, while each sense organ lies at the bottom of a deep cleft flanked on either hand by a rounded rhopalar lappet. In the Mediterranean *P. sicula* the rhopalar lappets are rounded and separated by notches from the tentacular lappets, which are entire (Mayer, 1910, p. 614, fig. 392). Just what the condition is in the specimens of *P. ornata* collected at Eastport by Verrill (1869) and afterwards by Fewkes (1888) is not clear, for while Mayer (1910) represents each of the tentacular lobes of one of the former as subdivided by deep

Digitized by Google

notches into two or three, in Fewkes's figures the tentacular lobe is merely slightly undulating in outline, his characterization of the lobes as "indented, incised, or scalloped," evidently referring to the notches separating the rhopalar lappets from the tentacular. As Fewkes's figures were drawn from life, and are evidently carefully made, and not at all diagrammatic, and as Verrill's specimen had been in alcohol upward of 20 years when Mayer examined it, it is likely that Fewkes's representation more clearly represents the normal condition.

Within recent years the genus has been recorded from the South Atlantic by Browne (1908) as *ornata* and from Japan and the Kurile Islands by Kishinouye (1910) as *sicula*. In Browne's specimen the tentacular lobes were not subdivided, but merely somewhat wavy in outline, and so are the specimens in the present collection. In Kishinouye's material they were entire. To summarize, then, specimens with entire or slightly wavy lappets—that is, all the recently described specimens of the genus—are known from the Mediterranean, the Bay of Fundy, the South Atlantic, Japan, the Kurile Islands, while the present collection contains two of this type from Bering Sea. Phacellophoras are also recorded from the west coast of the United States by A. Agassiz (1865) and Fewkes (1889), but without details as to their margins.

There seems to be nothing whatever to separate Browne's and Kishinouye's specimens specifically from the Mediterranean *sicula*, and I believe that the same is true of the Eastport form, *ornata*, for though Mayer's figure (1910) shows the mouth arms as *Aurelia*-like, he says in his characterization of the species that they are like those of *dubia*—that is, *Cyanea*-like—while in Fewkes's figure from life they are large, curtain-like, just as in *sicula*. The differences in the number of canals in the various recorded specimens also suggest nothing more than geographic varieties, if that. My own studies show that a little rough treatment is all that is needed to make the lappets split, for the gelatinous substance is very thin at the margin, and when this happens it might easily be mistaken for the normal condition, which suggests that no line can be drawn between Phacellophoras with entire and those with subdivided tentacular lobes. There is nothing to show that *ambigua*, *sicula* and *ornata* are not all one species. The case of *camtschatica* is not clear, because its marginal sculpture is so peculiar.

PHACELLOPHORA AMBIGUA (Brandt).

Plate 4, fig. 10; plate 5, fig. 5.

Haeckeloscomma ambiguum BRANDT, 1838, p. 380, pls. 27, 28.—A. AGASSIZ, 1865, p. 43.

Callinema ornata VERRILL, 1869, p. 117.—FEWKES, 1888, p. 235, pl. 6, fig. 1–4.

Phacellophora ornata HAECKEL, 1880, p. 643.—HARGITT, 1904, p. 68.—VANHÖFFEN, 1906, p. 59.—BROWNE, 1908, p. 247, pl. 2, fig. 3, 4.—MAYER, 1910, p. 617.

Phacellophora ambigua HAECKEL, 1880, p. 550.—VANHÖFFEN, 1906, p. 58.—MAYER, 1910, p. 615.

Digitized by Google

Phacellophora camtschatica HERTWIG, 1878, p. 113, 114, pl. 9, fig. 15; pl. 10, fig. 16 (not Brandt, 1835).

Phacellophora sicula HAECKEL, 1880, p. 551.—MAYER, 1910, p. 613, fig. 392.—KISHINOUYE, 1910, p. 21, fig. 2.

Station 4779, 54–0 fathoms, Bering Sea; 1 specimen 95 mm. in diameter.

Agattu Island, surface; 1 specimen, 170 mm. in diameter.

Also 3604, Bering Sea, August, 1895; fragments.

The smaller specimen is in fair, the larger one in perfect condition.

The smaller specimen agrees so well with Mayer's figure of a Mediterranean example that the latter might almost have been taken from it; the larger differs only in having more canals and tentacles and more complex mouth parts. As in Mayer's figure, each rhopalium is flanked on either side by a rounded lappet, separated from the tentacular (velar) lappet, which is likewise rounded, or slightly wavy, by a shallow notch (pl. 4, fig. 10), and practically the same condition is figured by Kishinouye (1910) and by Browne (1908), except that according to the former the rhopalar lappets are rather more pointed, while the latter represents the lappets as proportionately longer and narrower.

Two antimeres are irregular in having the rhopalar lappets unusually large, and the tentacular lappet entirely suppressed.

Canal system.—In the large specimen 91 canals leave the stomach, but by the branching of the rhopalar canals there are about 140 at the margin. In the smaller specimen there are 70 at the stomach, 149 at the margin; that is, there is individual variation, apart from size. In Mayer's Mediterranean specimen there were 64 canals at the stomach, and his figure shows about 110 at the margin; in Browne's South Atlantic specimen there were 42 at the stomach. The number of blind canals extending into each of the tentacular lobes varies from 2 large and 4 very minute in an antimere in which the place of the tentacular lappet is usurped by the rhopalia of lappets on either hand, to 10 or 11, the 5 or 6 in the middle being much the largest and obviously the oldest, those at either end very small indeed.

In the small specimen there are usually 5 or 6 canals to the lobe. Kishinouye (1910) shows 10, Browne (1908) 8, Mayer 5 to 8 for his Mediterranean, but only 2 to 5 for his Eastport specimen.

Mouth parts.—Each of the four mouth arms is about 100 mm. long, of the same general type as in *Cyanea*, though not so large; i. e., practically the condition figured by Mayer for *sicula*. In the smaller specimen the marginal folds of the mouth arms are largely torn away, leaving the stiff aboral axes, which in this mutilated state suggest the mouth arms of *Aurelia*, and in Mayer's figure of his Eastport specimen they seem to be in the same condition.

The rhopalia (pl. 5, fig. 5) have no ocelli and agree very well with Hertwig's figure. According to Mayer (1910, p. 614) there is "no

Digitized by Google

sensory pit in the exumbrella above the sense club," but in our specimen there is a distinct pit above each rhopalium.

Color.—In formalin the specimens are pale yellowish.

Genus AURELIA Péron and Lesueur.

The collection contains two easily distinguishable species of *Aurelia*, the well-known *aurita*, and the Arctic *limbata* first described by Brandt (1838) from the Bering Sea region. As Vanhöffen has pointed out, *limbata* is characterized by the complex branching and anastomosis of its canal system and by pigmentation; and these characters taken together give the medusa a general appearance so characteristic that it is identified at a glance.

The considerable series of the *aurita* group which I have studied, taken off the coasts of New England, in British waters, the North Sea, Cuba, Puget Sound, and Japan, all incline me to accept Vanhöffen's view that they can not be divided even into varieties, certainly not by the precise arrangement of the canals. According to Mayer (1910, p. 628) "*labiata*" is separable from *aurita* by the fact that its margin is cleft into 16 instead of 8 lappets, by the small diameter of the subgenital openings, and because the bell margin "projects downward from the subumbrella side as 8 plain-edged, velum-like folds spanning between the sense organs." But our 8 specimens from Puget Sound and Japan show very clearly that whether there are 8 or 16 marginal lobes is a question of contraction. In some few preserved specimens the margin is more or less retracted in the adradii, giving the "*labiata*" outline; in others the contraction has taken place in some of the adradii only; and one specimen from Cuba is especially instructive because there are four such false lappets in one octant.

The size of the subgenital openings seems to be subject to great variation—Mayer himself has shown very small ones in an *aurita* from the Tortugas—and they are very small in our Japanese specimens and in others from Cuba. In New England specimens they are large as a rule.

As to the structure of the margin, I may point out that it is exactly the same in *aurita* as it is described by Mayer (1910) for *labiata;* in both the tentacles arise some distance from the bell margin, and the intertentacular lobes are not discontinuous, as they are shown in L. Agassiz's beautiful figures, but are connected with one another below the tentacles by a continuous "shelf" which is the true margin. Below this, again, the velarium is situated.

There are two Aurelias besides *aurita* and *limbata*, which may perhaps deserve specific rank, *solida* Browne and *maldivensis* Bigelow, the former characterized by the vertical position of the rhopalia, the latter by the extreme development of the mouth-arms. But both of these demand further study.

Digitized by Google

AURELIA AURITA (Linnaeus) Lamarck.

Medusa aurita LINNAEUS, 1758, p. 660.

(For synonymy, see Mayer, 1910, pp. 623, 628.)

Tsuruga, Japan, July 23, surface; 3 specimens, 65, 90, and 130 mm. in diameter.

I can find nothing to separate these specimens from the Aurelias of the New England coast, except that they have smaller subgenital pits than is usually the case among the latter; but in this respect they agree with Cuban specimens. The branching of the canals is rather regular, just as in the Japanese specimens recorded by Maas (1909, var. "*colpota*"), but no more so than I have seen it in some Atlantic specimens; in fact an example of almost exactly the same type (though with only seven rhopalia) has been figured by Hargitt (1905*c*) from Massachusetts.

AURELIA LIMBATA Brandt.

Plate 5, figs. 1–4.

Aurelia limbata BRANDT, 1835, p. 26.—VANHÖFFEN, 1902*a*, p. 43; MAAS, 1906*b*, p. 507.

Diplocraspedon limbata BRANDT, 1838, p. 372, pl. 10.

Dutch Harbor, surface, May 25; 16 young specimens, 16–22 mm. in diameter.

Agattu Island, surface, June 7; 1 specimen, now in fragments, about 200 mm. in diameter.

Mororan, Hokkaido, Japan, surface, July 5; 2 specimens of about 100 mm.; 1 very fragmentary, the other with subumbrella, part of margin, gonads, subgenital pits, and two mouth-arms intact.

Station 5008; surface, 1 specimen, 43 mm. in diameter.

This species resembles *aurita* in general form as well as in the fact that the exumbrella is thickly set with minute tubercles, giving a hoary appearance. The subgenital openings are of moderate size.

No one of the large specimens is perfect; but the two most important features from the systematic standpoint, canal system and margin, are well preserved over at least a part of the periphery, in all.

Canal system.—In the large specimens the canal system is so characteristic that it identifies them at a glance (pl. 5, fig. 1). The interradial groups rise as one trunk, the perradials usually as three trunks; in either case the original trunks soon divide and subdivide, while the resultant branches anastomose among themselves and with the outer portions of the adradials, until the entire subumbrella is occupied by an exceedingly close-meshed and complicated canal-net, in which the adradials are conspicuous by the fact that they are independent for the inner two-thirds of their length.

In the smallest specimen (16 mm.) the adradials are unbranched, and each per- and interradial group arises as a single trunk, which

Digitized by Google

shortly bifurcates; and close to the margin there is some further branching. In a specimen of 20 mm. the per- and interradials still start as a single trunk; but the peripheral branching and anastomosis is already much more extensive, and the outer third of the adradials is now involved in it (pl. 5, fig. 4), and the margins of all the canals are jagged. By the time a diameter of 32 mm. is reached there is a marked advance in the complexity of the branching.

Mouth parts.—Unfortunately the mouth parts are damaged in all the specimens; but so far as can be seen they are of the usual *Aurelia* type. In one example of about 100 mm. two of the mouth-arms are intact; they are slightly longer than the bell radius.

Margin.—The velarium is much broader than in *aurita*, and the oldest of the intertentacular lobes longer and pointed, but there are all stages in the development of the latter and of the tentacles. As in *aurita* (p. 98), the tentacles arise some distance above the margin, the lobes not being discontinuous, but connected with one another below the tentacles.

The rhopalia (pl. 5, figs. 2, 3) resemble those of *A. aurita* in general, there being a broad, shallow, radially corrugated exumbral pit above the sense club, and below it a narrow, tubular one opening into the notch at the bottom of which the latter is situated. The club itself stands in an oblique position, neither horizontal, as is usual in *aurita*, nor vertical, as in the form described by Browne (1905) as *solida*.

The most striking feature of the margin is that velarium, margin, and lappets are heavily pigmented. In the preserved specimens they are amber-brown, and one of Mertens's figures from life (Brandt, 1838) shows this same color, but in his other figure they are deep sepia-brown. The color is as dense in our specimen of 30 mm. as it is in the larger ones; but in the specimen of 60 mm. observed by Mertens (Brandt, 1838, *A. hyalina*) there was no pigment.

Suborder RHIZOSTOMATA.

Genus MASTIGIAS L. Agassiz, 1862.

MASTIGIAS PAPUA (Lesson) L. Agassiz.

Cephea papua Lesson, 1826, p. 122, pl. 11, figs. 2, 3.

(For synonymy, see Mayer, 1910, p. 678.)

Nagasaki, Japan, surface, August 8; 3 specimens, 20–35 mm. in diameter.

These specimens are apparently identical with the Japanese material described by Kishinouye (1895) as *M. physophora*, except that like the Japanese specimens studied by Maas (1909) they have lost all color in the preservative. As Maas (1903, 1909) has shown, *physophora* is at most a variety of *papua*, with which Mayer (1910) has unequivocally united it. I believe the latter is correct.

Digitized by Google

Genus CEPHEA Péron and Lesueur, 1809.

Mayer (1910) has given an excellent account of this genus, and has pointed out that since in all known species of *Cephea* the mouth-arms "give rise to secondary dichotomous or dendritic branches and all are laterally compressed" there is no distinction between it and *Netrostoma*. The several members of *Cephea*, though differing widely from one another in their extremes, are connected by so many intermediate conditions that the separation of the species is difficult and probably largely artificial.

The collection contains a single well-preserved *Cephea* which agrees very well with the *C. setouchiana* of Kishinouye, especially in having a rather high dome with numerous protuberances, and a unitary four-lobed subgenital cavity, a character which it shares with *C. coerulescens* Maas. According to Mayer, *setouchiana* is a variety of *C. cephea*, *coerulescens* of *C. octostyla*, the two species being separated by the conformation of the central exumbral dome. This character is a variable one, as Mayer himself has found; but as I have studied only a single specimen of the genus, his classification is adopted here for the sake of uniformity. Kishinouye's account (quoted by Mayer, 1910, p. 657) applies so well to our specimen that no description is called for here.

CEPHEA CEPHEA (Forskål), var. SETOUCHIANA (Kishinouye) Mayer.

Microstylus setouchianus KISHINOUYE, 1902, p. 11, pls. 1, 2.
Netrostoma setouchianus BROWNE, 1905*a*, p. 967.
Cephea cephea, var. *setouchiana* MAYER, 1910, p. 657, fig. 409.

Nagasaki Harbor, August 5; 1 specimen, 80 mm. in diameter.

Genus RHOPILEMA Haeckel, 1880.

RHOPILEMA ESCULENTA Kishinouye.

Rhopilema esculenta KISHINOUYE, 1891*b*, p. 53; 1899, p. 20, pl. 13, figs. 1–5.—MAYER, 1910, p. 705, fig. 423.
? *Rhopilema rhopalophora* HAECKEL, 1880, p. 596.

Kagoshima Gulf, Japan, August 16, surface; 1 excellent specimen, about 140 mm. in diameter.

Kishinouye's (1899) account of this species, quoted by Mayer, is so good that no description is necessary here.

GEOGRAPHICAL DISTRIBUTION.

The chief interest of the collection, from the zoogeographic standpoint, is that it throws fresh light on the relationships of the medusa fauna of Bering Sea to that of other parts of the north Pacific on the one hand, and to that of the Arctic Ocean and north Atlantic on the other: and it affords our first information of the siphonophore fauna of the northwestern Pacific.

Some 40 species of medusae are now recorded from the region including Bering Sea, the Aleutian chain, the neighborhood of the Shumagin Islands, and the east coast of Kamchatka, the known

Digitized by Google

occurrence of which, in other regions, is shown on the table with the exception that two species are omitted, *Aequorea aequorea*, because our knowledge of its several varieties is still so chaotic that it is not advisable to make any use of them as yet in discussions of zoogeography, and the "species *incerta*" of Murbach and Shearer (1903), a peculiar codonid, because known from a single poorly preserved specimen.

Distribution of Bering Sea species.

	Tropical Indo-Pacific.	East coast Nipon-Hondo.	East coast Hokkaido.	Sea of Japan.	Kurile Islands.	Sea of Okhotsk.	California.	Puget Sound-Alaska.	Bering Sea.	White Sea, Barents Sea.	Spitsbergen.	Norway.	Greenland-Iceland.	Labrador Current.	New England.	North Sea, etc.	United States south of 42° N.	Europe south of 50° N.	Tropical Atlantic.
1. MEDUSAE.																			
Sarsia princeps							X	X	X	X	X	X	X	X					
Sarsia eximia									X				X		X	X		X	
Sarsia japonica			X			X			X	?	?		?						
Hybocodon prolifer							X		X		X	X	?		X				
Bougainvillea superciliaris							?	?	X	X	X	X	X	X	X	X	X		
Bougainvillea bougainvillei							X	X	X	?	?	?	?	?	?	?	?		
Rathkea blumenbachii		X							X	X		X	X	X	X	X	X	X	
Meator rubatra									X										
Pandea rubra								X	X										
Catablema vesicaria									X	X	X		X	X	X				
Catablema multicirrata					X			X	X										
Calycopsis nematophora									X										
Heterotiara anonyma	X							X	X										
Proboscydactyla flavicirrhata							X	X	X										
Tiaropsis diademata									X	X				X	X	?			
Eutonina indicans									X							X			
Staurophora mertensii	?				X			X	X	X		X	X	X	X	X	X		
Ptychogena lactea			X			X			X	X			X	X	X				
Gonionemus vertens var. *depressum*		X						?	X										
Aglantha digitale			X	X	X	X		X	X	X	X	X	X	X	X	X	X		
Crossota brunnea var. *norvegica*						X		X	X										
Ptychogastria polaris									X	X	X	X	X	X					
Pantachogon haeckeli						X		X	X		X		X						
Botrynema ellinorae									X				X						
Halicreas papillorum	X	X				X			X								?	?	X
Aegina rosea	X	X							X								?		X
Aeginura grimaldii	X	X							X									X	X
Solmissus incisa	X								X								X		?
Aeginopsis laurentii				X					X	X	X		X	X					
Halicystus stejnegeri									X		?	?	?	?	?	?			
Periphylla hyacinthina	X	X				X	X		X				X	X		X			
Atolla wyvillei	X	X							X								?	?	?
Cyanea capillata var. *capillata*					X	X			X	X	X	X	X	X	X	X			
Chrysaora helvola	?				X		X	X	X										
Chrysaora melanaster						X			X										
Pelagia species	X	X							X								X	X	X
Aurelia aurita	X	X	X		X		X	X	X	X		X	X	X	X	X	X	X	X
Aurelia limbata			X		X	X			X				?						
2. SIPHONOPHORAE.																			
Rosacea plicata	X			X		X			X									X	
Vogtia pentacantha		X				X			X									X	
Diphyes arctica			X	X	X	X			X	X	X	X	X			X			
Diphyes truncata	X	X						X	X			X						X	

The most striking thing illustrated by the table is the paucity of a peculiar Bering Sea fauna, if indeed there be any. Thus there are only two Craspedotae so far known from Bering Sea, the neighborhood

Digitized by Google

of the Aleutians, and the Sea of Okhotsk alone, that is, *Meator rubatra* and *Calycopsis nematophora*, both described here for the first time. And though the second may fairly be assumed to be restricted to the Bering Sea region, because it is a surface species and has not been taken elsewhere although the genus to which it belongs is widely distributed, the first is certainly a member of the mesoplankton, for which reason it is unsafe to assume that it will not prove to be much more widely distributed than now appears, when the bathymetric province to which it belongs is better known. The same is true of *Pandea rubra*, recorded from Bering Sea and from off the coast of British Columbia, and it is questionable whether the single Scyphomedusae peculiar to the Bering Sea region, *Haliclystus stejnegeri* Kishinouye, is really separable from *H. auricula*.

The remaining species are easily classified as to their relationships, systematic and geographic. In the first place, there are four "intermediate" cosmopolitan species, belonging that is, to the mesoplankton, *Halicreas papillosum*, *Aeginura grimaldii*, *Periphylla hyacinthina*, *Atolla wyvillei*, and one cosmopolitan surface form, *Aurelia aurita*, while two others, *Solmissus incisa* and *Aegina rosea*, if not cosmopolitan, are at least widely distributed both in the Atlantic and in the Indo-Pacific. Then one, *Bougainvillea bougainvillei*, is probably identical with the other member of the same genus mentioned in the list, *B. superciliaris*. *Sarsia princeps*, *S. eximia*, *Hybocodon prolifer*, *Bougainvillea superciliaris*, *Rathkea blumenbachii*, *Catablema vesicaria*, *Tiaropsis diademata*, *Eutonina indicans*, *Staurophora mertensii*, *Ptychogena lactea*, *Aglantha digitale*, *Pantachogon haeckeli*, *Botrynema ellinorae*, *Aeginopsis laurentii*, *Haliclystus*, and *Cyanea capillata* var. *capillata*, are characteristic members of the medusa fauna of the boreal Atlantic, or of the Arctic Ocean; *Aurelia limbata* probably occurs in Greenland waters (Vanhöffen, 1902*a*) and *Sarsia japonica* may be identical with an Arctic species, *S. flammea*, while *Catablema multicirrata* is a member of a genus which, as here defined, is known only from the boreal Atlantic and from the Arctic Ocean. Six species, on the other hand, clearly have an Indo-Pacific origin. These are *Heterotiara anonyma*, which is widely distributed in the intermediate depths of the Indo-Pacific, but is not known from the Atlantic; *Proboscydactyla flavicirrata*, a Pacific species which finds its closest ally in the only other member of the genus, *ornata*,[1] one or other variety of which is recorded from various localities in the tropical Atlantic and the Pacific and Indian Oceans; *Gonionemus vertens* var. *depressum*, which is represented in the north Atlantic by a close ally; and *Chrysaora helvola*, which is so far known only from the two sides of the northwestern Pacific, though it is certainly

[1] I have recently examined two excellent specimens of *flavicirrata* from Puget Sound, finding that the mode of branching of the canal agrees very well with Brandt's (1838) figure; this separates them, as I supposed (1909*b*), from *ornata*.

Digitized by Google

very close to the Atlantic *C. hysoscela*, if indeed it is separable from it at all. *C. melanaster*, too, is so far known only from the northwestern Pacific; and the *Pelagia* is a representative of a tropical and subtropical genus, a casual visitor from the south.

Thus, as might have been expected on oceanographic grounds, it is evident that the medusa fauna of the Bering Sea region has been recruited from two directions, there being a constituent from the warmer waters of the Pacific on the one hand and, on the other, a more important one, numerically, from the cold Arctic waters, which must have entered Bering Sea by way of Bering Straits.

Most of the leptoline species of northern origin are known from the region extending from Cape Cod to southern Labrador, while one, *Eutonina socialis*, occurs in the North Sea; that is, they are boreal rather than purely Arctic, though several are known from Arctic stations; and this is what we might have expected, for in summer the temperature of the surface waters of the southern part of Bering Sea is from 50° to 57°; that is, about as warm as the waters of the northern parts of the Gulf of Maine on the New England coast and considerably warmer than the surface waters of the Labrador current off Labrador. And for this same reason it is probable that collections made during the late summer would contain a greater number of southern species, for the Fisheries steamer *Albatross* records are limited to May and the early part of June.

The Bering Sea list includes four siphonophores, all long-known species. One of them, *Diphyes arctica*, previously recorded only from Arctic and boreal regions (1911*b*), was taken regularly on the present cruise in cold waters, but was entirely absent in the warm waters of the Eastern Sea and of Kuro shiro. Like the Arctic and boreal medusae, it probably reached the Bering Sea region from the north, i. e, by way of Bering Straits. But, as Doctor Moser, who is now working on the siphonophores of the German South Polar Expedition, writes me that the *Gauss* took it in many localities, further discussion of its distribution is best postponed until her data is published.

The three other siphonophores are all species of wide distribution in both Atlantic and Indo-Pacific, *Rosacea plicata* and *Diphyes truncata* being known from tropical as well as from temperate stations and *Vogtia pentacantha* from the Bay of Biscay and from the Mediterranean. But as none of them has ever been recorded from Arctic temperatures, it is safe to assume that they colonized Bering Sea from the south. They were all taken there so regularly that they are to be considered characteristic members of its pelagic fauna.

The collection suggests the probability that certain species of medusae belonging to intermediate depths may be confined to Arctic-boreal regions; a generalization of great zoogeographic interest if it

Digitized by Google

proves to be well founded. This tentative conclusion (of course it may have to be modified) is based on the occurrence of *Pantachogon haeckeli* and of *Crossota brunnea* var. *norvegica*. If these species had been represented by only a few scattered captures, we might well hesitate to use them as instances of geographic range; but both were taken in considerable numbers at 10 stations each, and the regularity of their distribution is striking when we observe that only 14 hauls with the intermediate net from 300 fathoms were made south of the Shumagin Islands, in Bering Sea and in the Sea of Okhotsk, in 11 of which one or other of the two species was taken (in six hauls the two were taken together; each was likewise taken in the trawl). On the other hand, both were conspicuously absent in the intermediate hauls made in Japanese waters, nor are they represented in the extensive collections made by the *Albatross* off the coasts of California, British Columbia, and southern Alaska, which have passed through my hands. In the Atlantic, too, these two species have been taken only at far northern stations, though the expeditions of the *National*, of the *Valdivia*, and of the Prince of Monaco might have been expected to reveal them in the warmer parts of the Atlantic were they as common there as in Bering Sea, or as are such genera as *Halicreas*, *Periphylla*, and *Atolla*. And the fact that *P. haeckeli* is represented by a distinct, though allied, species, *scotti*, in the Antarctic and *C. brunnea* var. *norvegica* by a recognizable variety in tropical regions, is also strong evidence that the two are restricted to northern regions. The collection made by the *Michael Sars*, now being studied by Doctor Broch, may throw further light on this subject, but we are probably safe in assuming that both *Pantachogon* and *Crossota* entered Bering Sea from the north.

Botrynema ellinorae is likewise known only from "intermediate" hauls in Bering Sea and in the Arctic Ocean; but the records of its captures are too few to warrant the assumption that it is confined to high latitudes, while the fact that its close ally, *brucei*, is Antarctic, suggests that the genus, at least, will be found in the deeper water layers of low latitudes. It is not improbable that the two new "intermediate" species, *Pandea rubra* and *Meator rubatra*, may belong to the same category, for their occurrence in the northwestern Pacific closely parallels that of *Pantachogon* and *Crossota;* but, as pointed out above, it is best to suspend judgment on this point for the present.

We can not trace the cold water medusae southward along the west and east sides of the northwestern Pacific as well as we could wish, because we know very little about the medusae of the American coast between the Aleutians and Puget Sound. But the collections from the latter region, recorded by A. Agassiz (1865) and by Murbach and Shearer (1903), and a series in the Museum of Com-

Digitized by Google

parative Zoology collected by Professor Kincaid, give a fair idea, though certainly far from a complete survey, of its medusa fauna. The combined list from Puget Sound, coast of Washington, and southern British Columbia, is as follows:

Sarsia rosaria.
Sarsia eximia.
Stomotoca atra.
Neoturris brevicornis.
Catablema multicirrata.
Bougainvillea bougainvillei.
Proboscydactyla flavicirrhata,
Polyorchis penicillatum.
Polyorchis minuta.
Melicertum georgicum.
Staurophora mertensii.
Halistaura cellularia.
Phialidium gregarium.
Aequorea aequorea.
Gonionemus vertens.
Aglantha digitale.
Cyanea arctica (colorless var.).
Dactylometra species?
Chrysaora helvola.
Phacellophora species?
Aurelia aurita.

Likewise the siphonophores, *Diphyes appendiculata, Physalia, Porpita,* and *Velella;* and the present collection contains specimens of *Heterotiara anonyma* and *Crossota pedunculata* taken in intermediate hauls off British Columbia.

The general character of this list differs from that of Bering Sea by the appearance of the very noticeable genera *Polyorchis, Halistaura, Dactylometra,* and by the tropical siphonophores *Physalia, Porpita,* and *Velella,* while the dark-colored *Cyanea* of the north is replaced by a colorless variety, of which I have seen examples. At the same time seven of the Bering Sea species are also known from the Puget Sound region, while it would not be surprising to find *Sarsia rosaria* (? *tubulosa*), *Melicertum,* and *Phialidium* in Bering Sea, judging from the occurrence of these genera in the north Atlantic.

As we pass southward from the Puget Sound region, we find only a few scattered records of medusae until we reach San Diego. And somewhere in this long stretch the cold-water species which compose the great bulk of the medusa fauna of Bering Sea entirely disappear, the most southerly record for any of them on the surface being Fewkes's (1889) capture of *Hybocodon prolifer* at Santa Barbara, though the northern *Aglantha digitale* is represented by a distinct variety in the intermediate depths of the tropical Pacific (1909*a*). The only Leptomedusa known to be common to San Diego and to Bering Sea is the cosmopolitan *Aequorea aequorea,* and even in this case it is doubtful whether it is represented by the same variety.

On the western side of the Pacific the available data is more extensive, thanks to the collections from Japan recorded by Maas (1909) and by Kishinouye (1902, 1910), and to the Fisheries steamer *Albatross* series from the southern part of the Sea of Okhotsk, a virgin field, and the Eastern Sea south of Japan. The species taken in the Sea of Okhotsk are *Sarsia japonica, Calycopsis nematophora, Ptychogena lactea, Tima saghalinensis, Aglantha digitale, Crossota brunnea,*

Digitized by Google

var. *norvegica*, *Pantachogon haeckeli*, *Halicreas papillosum*, *Periphylla hyacinthina*, *Aurelia limbata*, and the siphonophore *Vogtia pentacantha;* all, except the *Tima*, also taken in Bering Sea; and the one exception may be expected to turn up there, as it is a new species known only from one record.

Cyanea capillata, *Aurelia limbata*, *Staurophora mertensii*, and the genus *Chrysaora* are also known from the southern end of Sakhalin Island, besides the genera *Urashimea*, *Nemopsis*, and *Polyorchis*, recorded by Kishinouye.

Eight of the Bering Sea medusae are known from the Kurile Islands, among them the typical cold-water forms *Staurophora mertensii*, *Aglantha digitale*, the dark-colored variety of *Cyanea capillata*, *Aurelia limbata*, and *Diphyes arctica;* but on the other hand, the eudoxid of *Nectopyramis diomedae*, a species previously recorded only from the tropical Pacific, was likewise taken off the Kurile Islands, but it is known from so few captures that it can not be assigned to any definite temperature zone. *Catablema multicirrata*, *Chrysaora helvola*, *Sarsia tubulosa*, *Phacellophora ambigua*, and the peculiar Stauromedusa *Thaumatoscyphus* have likewise been recorded from the Kuriles by Kishinouye.

In examining the records of the *Albatross* from the Sea of Japan we are confronted by the rather surprising fact that although the intermediate 5-foot net and the small plankton nets were used at 15 of the 86 trawling stations occupied, medusae were taken in only 3 hauls. Only four species of medusae were taken; i. e., *Liriope tetraphylla*, *Aglaura hemistoma*, *Aglantha digitale*, *Dactylometra pacifica*, and three siphonophores, *Rosacea plicata*, *Diphyes arctica*, and *D. truncata;* while the only previous records which I have been able to find are that of *Aeginopsis laurentii*, by Haeckel (1879) and *Parumbrosa polylobata* by Kishinouye (1910).

The apparent absence of the smaller surface medusae might perhaps be credited to their being overlooked in the mixed plankton; but we can not account in this way for the failure to find any of the larger red "intermediate" genera, as for example, *Atolla*, *Periphylla*, *Aeginura*, because they are made exceedingly conspicuous by their color. And as none of them were taken, it is fair to assume that the scarcity of the medusae on the Sea of Japan is a real, not an apparent phenomenon.

The short list includes three warm water members, *Aglaura*, *Liriope*, *Dactylometra*, and two cold water ones, *Aglantha* and *Diphyes arctica*, with two, *Rosacea plicata* and *Diphyes truncata*, which are probably cosmopolitan; and data of the specimens shows that *Aglaura* and *Liriope* were taken on the surface, while *Aglantha* and *Diphyes* were encountered only in intermediate hauls, the difference in bathymetric range being well illustrated by the coincidence that *Aglaura*

Digitized by Google

was taken on the surface close by the spot where the two cold water species were brought up from the deeper waters, the surface temperatures being 77°–80°, that at 245 fathoms 33.1°. Haeckel's record of *Aeginopsis* unfortunately gives neither the date, whether winter or summer, nor the exact locality. And both of these are of importance, because in summer the surface temperatures of the Sea of Japan range from about 60° (northern end) to about 80° (Korea Channel); while in winter the surface waters of its northern half, between Hokkaido and the Siberian coast, are cooled to 45° or less.

In the portion of the Eastern Sea south of the Straits of Korea traversed by the *Albatross*, the hauls brought to light an abundant harvest of medusae, the species taken near the Goto Islands, off Kagoshima Gulf, and off Kyushiu Island being—

1. MEDUSAE.

Turritopsis nutricula.
Aequorea pensile.
Olindioides formosa.
Aglaura hemistoma.
Rhopalonema velatum.
Colobonema typicum.
Crossota alba.
Liriope tetraphylla.
Geryonia proboscidalis.
Solmundella bitentaculata.
Periphylla hyacinthina.
Nausithoë punctata.
Atolla wyvillei.
Pelagia panopyra.
Sanderia malayensis.
Parumbrosa polylobata.

2. SIPHONOPHORAE.

Rosacea plicata.
Nectodroma reticulata.
Hippopodius hippopus.
Vogtia pentacantha.
Abylopsis tetragona.
Bassia bassensis.
Clausophyes galatea.
Galeolaria australis.
Galeolaria monoica.
Chuniphyes multidentata.
Diphyes truncata.
Diphyes appendiculata.
Diphyes contorta.
Diphyes spiralis.
Diphyopsis dispar.
Diphyopsis mitra.
Diphyopsis chamissonis.
Agalma okeni.
Archangelopsis typica.
Porpita pacifica.

The list is essentially tropical, as might have been expected from the surface temperatures (83°–85°) at the season the collection was gathered, all the surface medusae being known from the tropical parts of the Pacific or Indian Oceans, except *Turritopsis nutriculata*, *Olindioides*, and *Parumbrosa polybata*, the last two known only from Japan. All the siphonophores, except *Vogtia pentacantha*, are known from the tropical Pacific, or from the Malaysian region, while most of them are characteristic of the warmer regions of all three great oceans.

During the summer months, when the southeastern coasts of Japan are bathed by the warm Kuro Shiro current, the tropical holoplanktonic coelenterate fauna extends northward along the coast of Nipon, at least as far as Suruga and Sagami Bays, where

Digitized by Google

the combined records of Kishinouye (1902, 1910), Maas (1909), Doflein (1906), and the Fisheries steamer *Albatross*, have revealed the following tropical species: *Cytaeis vulgaris*, *Clavula papua*, *Proboscydactyla ornata*, *Phialidium pacificum*, *P. discoida*, *Aequorea pensile*, *Liriope tetraphylla*, *Geryonia proboscidalis*, *Rhopalonema velatum*, *Aglaura hemistoma*, *Solmundella*, *Cunina peregrina*, *Charybdea rastonii*, *Pelagia panopyra*, *Sanderia malayensis*, *Dactylometra pacifica*, *Thysanostoma thysanura* and *Mastigias papua*, with the following siphonophores, *Abylopsis tetragona*, *Diphyes appendiculata*, *Diphyopsis dispar*, *Diphyopsis chamissonis*, *Forskalea*, *Physalia*, *Porpita*, and *Velella;* all of them being widely distributed in the tropical parts of the Indo-Pacific.

This list suggests that the pelagic coelenterate fauna of the southeast coast of Japan in summer is overwhelmingly tropical; but such a conclusion is correct only for its holoplanktonic constituent—that is, for the inhabitants of the warm waters of the Kuro Shiro, and for certain scyphomedusae. With the leptoline forms quite a different state of affairs is to be seen, because the list does not include any of the leptoline hydromedusae which are the most characteristic members of the medusa fauna of the Philippines, the Malaysian region, or of the Maldives and tropical Pacific, such as *Bougainvillea fulva*, *Laodice fijiana*, *Tiaropsis rosea*, *Phialucium mbengha*, *Irenopsis hexanemalis*, *Eutima levuka*, *Octocanna polynema*, *Gonionemus suvaensis*, or the genera *Euphysora*, *Phortis*, or *Olindias*. A full list of the Philippine, Malaysian, and tropical West American hydromedusae, and their distribution, will be found in my report on the *Albatross* Philippine medusae.

In Japanese waters the place of *Olindias* is taken by *Olindioides*, of the tropical *Gonionemus suvaensis*, by *G. vertens*, var. *depressum*, which is a close ally of the *Gonionemus* of the cold waters of Puget Sound, and of New England. Other Japanese leptoline forms recorded by Kishinouye (1910) and by Maas (1909), such as *Nemopsis dofleini*, *Willia pacifica*, *Spirocodon saltatrix*, are peculiar to Japan, so far as we know yet. The absence of the typically tropical leptoline species, which are so common among the Philippines, is probably not an accidental failure in collection, but is an actual condition, due to the low temperature of the waters off the east coast of Japan in winter, which they, or their hydroids, can not survive. But in the case of the holoplanktonic species, this bar is operative only in winter, for they are brought to Japan in summer by the Kuro Shiro, when the latter spreads toward the north.

Unfortunately we have almost no data on the medusa fauna of the east coast of Nipon, north of Yokohama Bay; indeed I have not been able to find a single definite record; but we can safely assume that before Tsugaru Strait is reached the tropical contingent

Digitized by Google

of the medusa and siphonophore fauna swings away from the coast, with the easterly trend of the Kuro Shiro current, because the few species previously known from the east coast of Hokkaido, and those found there by the *Albatross*, that is, *Sarsia japonica*, *Ptychogena lactea*, *Aglantha digitale*, *Haliclystus auricula*, *Aurelia aurita*, *Aurelia limbata*, and *Diphyes arctica*, are of a distinctly northern cast.

In summer the warm Kuro Shiro water, with its characteristic fauna, is periodically driven out from the shore off Tsuruga Gulf, by northwest winds, and its place taken by much colder water (Doflein, 1908); and the few available winter records, for example, *Rathkea blumenbachii* and *Phacellophora ambigua* from Misaki (Kishinouye), show that some northern species reach the coasts of Nipon at that season; whether any of them do so in summer is not yet known.

An interesting parallel may be drawn between the pelagic coelenterate fauna of the northeastern coasts of Asia and that of the northeast coast of the United States. It has, of course, been long recognized that the east coast of Japan and the southern shores of New England share certain striking oceanic phenomena, both being bathed in winter by cold, almost Arctic waters of northern origin, which in summer are periodically displaced by the northerly swing of a very warm current, the Kuro Shiro in the Pacific, the Gulf Stream in the Atlantic. On the Japanese coast the warm stream holds almost continuous sway in summer; but on the south coast of New England its full effect is felt only occasionally, though it tempers the surface waters to a marked degree throughout the warm months. Off the coast of Nipon, in the region of Sagami and Suruga Gulf the annual range of temperature is from about 50° to about 80°; off Narragansett Bay, in New England, from about 38° (it occasionally freezes in the bay) to about 76°; and of course even greater extremes and various anomalies are observed in partially enclosed waters.

To both of these regions the warm current brings an abundant tropical oceanic pelagic fauna in summer; but this deserts New England, and probably Japan, in autumn, when the warm waters to which it belongs recede. And in neither region is the leptoline medusa fauna tropical; thus there are very few leptoline species common to Narragansett Bay and to the West Indies, though the former receives a number of characteristic tropical oceanic medusae every summer; and the same is true of Japan; nor indeed would we expect to find litoral tropical species taking permanent foothold in regions where they would have to survive boreal temperatures at some stage of development.

In New England tropical medusae seldom penetrate north of Massachusetts Bay, beyond which point, in summer, we find boreal species such as *Melicertum campanula*, *Staurophora mertensii*, *Catablema*

Digitized by Google

vesicaria, which appear only in winter south of Cape Cod; and in Japan the Tsugaru Strait marks a similar division. But both in the Atlantic and in the Pacific there are records of the occurrence of tropical coelenterates from far north of their usual range, such as *Physalia* in the Bay of Fundy, *Pelagia* in Bering Sea.

In the cold season the process of dispersal is reversed, the warm-water species receding, the cold-water ones advancing toward the south. We do not know just how far southward boreal medusae extend along the coasts of the United States in winter, but several appear regularly at that season at Woods Hole and in Narragansett Bay, and I have myself seen the waters of Pamlico Sound (only a few miles north of Cape Hatteras) crowded with the dark red northern *Cyanea*, in January, after prolonged northeast storms. In Japan, as pointed out above, boreal species appear in Sagami Bay during the cold season, and it is probable that they advance even farther southward.

BIBLIOGRAPHY.

1865. AGASSIZ, A. North American Acalephae. Mem. Mus. Comp. Zoöl., Harvard Coll., vol. 1, pp. 14+334, 360 figs.

1883. ———. Exploration of the surface fauna of the Gulf stream. The Porpitidae and belellidae. Mem. Mus. Comp. Zoöl., Harvard Coll., vol. 8, pp. 16, 12 pls.

1899. ——— and MAYER, A. G. Acalephs from the Fiji Islands. Bull. Mus. Comp. Zoöl., Harvard Coll., vol. 32, pp. 157–189, 17 pls.

1902. ———. Reports on the Scientific Results of the Expedition to the Tropical Pacific, 1899–1900. III. The Medusae. Mem. Mus. Comp. Zoöl., Harvard Coll., vol. 26, pp. 149–176, 14 pls.

1849. AGASSIZ, L. Contributions to the Natural History of the Acalephae of North America. 1. On the naked-eyed Medusae . . . Mem. Amer. Acad., new ser., vol. 4, pp. 221–316, 8 pls.

1862. ———. Contributions to the Natural History of the United States of America. Boston, vol. 4, pp. 8+372+(12), pls. 20–35.

1859. ALLMAN, G. J. Notes on the Hydroid Zoophytes. Ann. Mag. Nat. Hist., ser. 3, vol. 4, pp. 137–144.

1871. ———. A Monograph of the Gymnoblastic or Tubularian Hydroids. London, Ray Soc., pp. 22+450, 23 pls.

1878. ———. Hydrozoa: in Capt. Sir G. S. Nares's Narrative of a Voyage to the Polar Sea during 1875–76, in H. M. Ships *Alert* and *Discovery*. London, vol. 2, pp. 290–292.

1904. BIGELOW, H. B. Medusae from the Maldive Islands. Bull. Mus. Comp. Zoöl., Harvard Coll., vol. 39, pp. 245–269, 8 pls.

1909*a*. ———. Reports on the Scientific Results of the Expedition to the Eastern Tropical Pacific, etc. XVI. The Medusae. Mem. Mus. Comp. Zoöl., Harvard Coll., vol. 37, pp. 243, 48 pls.

1909*b*. ———. Cruise of the U. S. Fisheries Schooner *Grampus* in the Gulf Stream during July, 1908, with description of a new Medusa (Bythotiaridae). Bull. Mus. Comp. Zoöl., Harvard Coll., vol. 52, pp. 195–210, 1 pl.

1909*c*. ———. Coelenterates from Labrador and Newfoundland, collected by Mr. Owen Bryant from July to October, 1908. Proc. U. S. Nat. Mus., vol. 37, pp. 301–320, pls. 30–32.

1911*a*. ———. Biscayan Plankton collected during a Cruise of H. M. S. *Research*, 1900. XIII. The Siphonophora. Trans. Linn. Soc. London, Zoöl., vol. 10, pp. 337–358, pl. 28.

Digitized by Google

1911*b*. BIGELOW, H. B. Reports on the Scientific Results of the Expedition to the Eastern Tropical Pacific, 1904–1905. XIII. The Siphonophorae. Mem. Mus. Comp. Zoöl., Harvard Coll., vol. 38, No. 2, pp. 175–401, 32 pls.

1835. BRANDT, J. F. Prodromus descriptionis animalium ab H. Mertensio in orbis terrarum circumnavigatione observatum. St. Petersburg, pl. 1, pp. 76.

1836. ————. Remarques sur . . . Acalèphes. Bull. Acad. Sci. Petersbourg, vol. 1, pp. 185–191.

1838. ————. Ausführliche Beschreibung der von C. H. Mertens auf seiner Weltumsegelung beobachteten Schirmquallen . . . Mem. Acad. St. Petersbourg, ser. 6, vol. 4, pp. 237–411, pls. 1–31.

1883. BROOKS, W. K. Notes on the Medusae of Beaufort, N. C. Part 2. Studies Biol. Lab., Johns Hopkins Univ., vol. 2, pp. 465–475.

1886. ————. The Life-History of the Hydromedusae. Mem. Boston Soc. Nat. Hist., vol. 3, pp. 359–430, pl. 37–44.

1891. ————, and CONKLIN, E. G. On the Structure and Development of the Gonophores of a certain Siphonophore belonging to the order Auronectae (Haeckel). Johns Hopkins Univ. Circulars, vol. 10, pp. 87–89, 1 pl.

1907. ————, and RITTENHOUSE, S. On Turritopsis nutricula (McCrady). Proc. Boston Soc. Nat. Hist., vol. 33, pp. 429–460, pl. 30–35.

1896. BROWNE, E. T. On British Hydroids and Medusae. Proc. Zool. Soc., London, pp. 459–500, pls. 16, 17.

1897. ————. On British Medusae. Proc. Zool. Soc., London, pp. 816–835, pls. 48, 49.

1902. ————. A Preliminary Report on Hydromedusae from the Falkland Islands. Ann. Mag. Nat. Hist., ser. 7, vol. 9, pp. 272–284.

1903. ————. Report on some Medusae from Norway and Spitzbergen. Bergens Mus. Arbog., No. 4, pp. 36, 5 pls.

1904. ————. Hydromedusae, with a Revision of the Williadae and Petasidae. Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 2, pp. 722–749, pls. 54–57.

1905*a*. ————. Scyphomedusae. Fauna and Geography of the Maldive and Laccadive Archipelagoes, vol. 2, pp. 958–971, pl. 94.

1905*b*. ————. The Medusae. Suppl. Rep. 27, Pearl Oyster Fisheries of the Gulf of Manar. Roy. Soc. London, pp. 131–166, 4 pls.

1907. ————. A Revision of the Medusae belonging to the Family Laodiceidae. Ann. Mag. Nat. Hist., ser. 7, vol. 20, pp. 457–480.

1908. ————. The Medusae of the Scottish National Antarctic Expedition. Trans. Roy. Soc., Edinburgh, vol. 46, pp. 233–251, 2 pls.

1910. ————. Medusae. National Antarctic Exped. Nat. Hist., vol. 5, Coelentera, No. 5, pp. 62, 7 pls.

1906. ————, and FOWLER, G. H. Biscayan Plankton, etc. Part 9. The Medusae. Trans. Linn. Soc. London, vol. 10, pp. 163–187, pl. 13.

1821. CHAMISSO, A. DE, et EYSENHARDT, C. G. De Animalibus quibusdam e Classe Vermium Linneana . . . Fasc. 2. Acad. Caes. Leop., Nova Acta, vol. 10, pp. 343–374, pls. 24–33.

1888. CHUN, C. Bericht über eine nach den Canarischen Inseln im Winter 1887–88 ausgeführte Reise. Sitz. Akad. Wiss. Berlin, vol. 44, pp. 1–33 [1141–1173].

1897*a*. ————. Ueber den Bau und die morphologische Auffassung der Siphonophoren. Verh. Deutsch. Zool. Ges., vol. 7, pp. 48–111.

1897*b*. ————. Die Siphonophoren der Plankton-Expedition. Ergeb. der Plankton Exp., vol. 2, K. b., 126 pp., 8 pls.

1863. CLAUS, C. Neue Beobachtungen über Structur und Entwickelung der Siphonophoren. Zeit. Wiss. Zool., vol. 12, pp. 536–563, pls. 46–48.

1883. ————. Untersuchungen über die Organisation und Entwicklung der Medusen. Prag und Leipzig, 96 pp., 20 pls.

Digitized by Google

1906. DOFLEIN, F. Fauna und Ozeanographie der Japanischen Küste. Verh. Deutsch. Gesell., vol. 16, pp. 62–72, 1 pl.

1825. ESCHSCHOLTZ, FR. Bericht über die Zoologische Ausbeute während der Reise von Kronstadt bis St. Peter und Paul. Oken's Isis, pp. 733–747, pl. 5.

1829. ————. System der Acalephen. Eine ausführliche Beschreibung aller Medusenartigen Strahlthiere. Berlin, pp. 6+190, 16 pls.

1780. FABRICIUS, O. Fauna groenlandica. Hafniae, 8°, pp. xvi+452, 1 pl.

1882*a*. FEWKES, J. W. Notes on Acalephs from the Tortugas, with a Description of New Genera and Species. Bull. Mus. Comp. Zoöl., Harvard Coll., vol. 9, pp. 251–289, 7 pls.

1882*b*. ————. On the Acalephae of the East Coast of New England. Bull. Mus. Comp. Zoöl., Harvard Coll., vol. 9, pp. 291–310, 1 pl.

1886. ————. Report on the Medusae collected by the U. S. Fish Commission Steamer *Albatross* in the Region of the Gulf Stream in 1883–84. U. S. Comm. Fish and Fisheries. Report of the Commissioner for 1884, pp. 927–980, pls. 1–10.

1888. ————. On certain Medusae from New England. Bull. Mus. Comp. Zoöl., Harvard Coll., vol. 13, pp. 209–240, 6 pls.

1889. ————. New Invertebrata from the Coast of California. Bull. Essex Inst., vol. 21, pp. 99–142, (2)+7 pls.

1848. FORBES, E. A Monograph of the British Naked-eyed Medusae. London, Ray Soc., pp. 104, 13 pls.

1775. FORSKÅL, P. Descriptiones animalium . . . quae in itinere orientali observavit, post mortem edidit Carstem Niebuhr. Hauniae, pp. 20+xxxiv+16, 1 map.

1776. ————. Icones rerum naturalium quas in itinere orientali depingi curavit Petrus Forskål . . . edidit Carstem Niebuhr. Hauniae, 15 pp., 43 pls.

1856. GEGENBAUR, C. Versuch eines system der Medusen, mit Beschreibung neuer oder wenig gekannter Formen. . . . Zeit. Wiss. Zool., vol. 8, pp. 202–273, pls. 7–10.

1886. GOETTE, A. Verzeichniss der Medusen welche von Dr. Sander, Stabsartz auf S. M. S. *Prinz Adalbert* gesammelt wurden. Sitz. Preuss. Akad. Wiss. Berlin, 1886, pp. 831–837.

1903. GOTO, S. The Craspedote Medusa Olindias and some of its Natural Allies. Mark Anniversary volume, Cambridge, pp. 1–22, pls. 1–3.

1841. GOULD, A. A. Report on the Invertebrates of Massachusetts. pp. xiii+372, 14 pls. Cambridge.

1857. GREENE, J. R. On the Acalephae of the Dublin Coast. Nat. Hist. Review, 1857, Part 4, pp. 242–250.

1898. GRÖNBERG, G. Die Hydroidmedusen des Arktischen Gebietes. Zool. Jahr., Abt. Syst., vol. 11, pp. 451–467, pl. 27.

1879. HAECKEL, E. Das System der Medusen. Theil 1. System der Craspedoten. Jena Denkschr., vol. 1, pp. 25+360, atlas of 40 pls.

1880. ———— System der Acraspeden. Zweite Hälfte des Systems der Medusen. Jena. Denkschr., vol. 1, 2 abth., pp. 361–672.

1881. ———— Report on the Deep Sea Medusae . . . Report on the Scientific Results of the Voyage of H. M. S. *Challenger*. Zoology, vol. 4, pp. 105+154, 32 pls.

1888. ———— Siphonophorae of the *Challenger*. Rept. sci. results . . . H. M. S. *Challenger*. Zoology, vol. 28, pp. 380, 50 pls.

1905*a*. HARGITT, C. W. Notes on the Variations of Rhegmatodes. Biol. Bull., vol. 9, pp. 368–377, 14 figs.

1905*b*. ———— The Medusae of the Woods Hole Region. Bull. U. S. Bureau Fisheries, vol. 24, pp. 21–79, pls. 1–7.

Digitized by Google

1905c. HARGITT, C. W. Variations among Scyphomedusae. Journ. Exper. Zool., vol. 2, pp. 547–584, 1 pl.

1894. HARTLAUB, C. Die Coelenteraten Helgolands. Beitr. Meeresfauna von Helgoland. IV. Wiss. Meeresunters. . . . deutschen Meere in Kiel. . . . vol. 1, pp. 161–206.

1897. ———— Die Hydromedusen Helgolands. Beitr. Meeresfauna von Helgoland. X. Wiss. Meeresunters. . . . deutschen Meere . . . vol. 2, pp. 451–512, pls. 14–23.

1907. ———— Craspedote Medusen. 1 Theil, 1 Lief. Codoniden und Cladonemiden. Nordisches Plankton, 12. 135 pp., 1 pl.

1909a. ———— Méduses, in Duc d'Orléans Croisière Océanographique . . . dans la Mer du Grönland, 1905. 18 pp., pls. 76–77.

1909b. ———— Ueber einige von Ch. Gravier in Djibuti gesammelte Medusen. Zool. Jahrb., Abt. Syst., vol. 27, pp. 447–476, pls. 19–23.

1911. ———— Craspedote Medusen. 1 Theil, 2 lief. Margelidae. Nordisches Plankton, 12. pp. 137–235.

1878. HERTWIG, O., und HERTWIG, R. Das Nervensystem und die Sinnesorgane der Medusen. Leipzig, pp. 186, 10 pls.

1859. HUXLEY, T. H. The Oceanic Hydrozoa. London, 141 pp., 12 pls.

1862. KEFERSTEIN, W. Untersuchungen über niedere Seethiere. Zeit. Wiss. Zool., vol. 12, pp. 1–148, pls. 1–11.

1861. ———— und EHLERS, E. Zoologische Beiträge gesammelt im Winter 1859–1860 in Neapel und Messina. I. Beobachtungen über die Siphonophoren. Leipzig, pp. 1–34, pls. 1–5.

1891a. KISHINOUYE, K. Cyanea nozakii, n. sp. (Japanese, with German diagnosis). Zool. Mag. Tokyo, vol. 3.

1891b. ————. Zool. Mag. Tokyo, vol. 3, p. 53. (Japanese, with German diagnosis.)

1892. ———— Zwei neue Dactylometren. (Japanese, with German diagnosis.) Zool. Mag. Tokyo, vol. 4.

1895. ———— Description of a new Rhizostoma, Mastigias physophora. Zool. Mag. Tokyo, vol. 7.

1899a. ———— Edible Medusae. Zool. Jahrb., Abt. Syst., vol. 12, pp. 205–209, pl. 13.

1899b. ———— A new species of stalked Medusae, Haliclystus stejnegeri. Proc. U. S. Nat. Mus., vol. 22, pp. 125–129.

1902. ———— Some new Scyphomedusae of Japan. Journ. Coll. Sci. Tokyo, vol. 17, art. 7, pp. 17, 2 pls.

1910. ———— Some Medusae of Japanese Waters. Journ. Coll. Sci. Tokyo, vol. 27, art. 9, pp. 35, 5 pls.

1853a. KÖLLIKER, A. In "Bericht über einige im Herbst 1852 in Messina angestellte vergleichend anatomische Untersuchungen von C. Gegenbaur, A. Kölliker, und H. Müller." Zeit. Wiss. Zool., vol. 4, pp. 299–370. [Ueber scheibenquallen, by A. Kölliker, pp. 320–329.]

1853b. ———— Die Schwimmpolypen oder Siphonophoren von Messina. Leipzig, pp. 96, 12 pls.

1801. LAMARCK, J. B. P. A. DE M. DE. Systême des Animaux sans Vertèbres . . . Paris, 432 pp.

1816. ———— Histoire Naturelle des Animaux sans Vertèbres. Paris, vol. 2, 568 pp.

1884. LENDENFELD, R. VON. The Australian Hydromedusae. Proc. Linn. Soc., New South Wales, vol. 9, pp. 581–634, pls. 20–29.

1908. LENS, A. D., and VAN RIEMSDIJK, TH. The Siphonophora of the *Siboga* Expedition. "*Siboga*" Expeditie. Monograph 38, pp. 130, 24 pls.

Digitized by Google

1826. LESSON, R. P. Voyage autour du monde . . . sur la Corvette de sa Majeste, *La Coquille*, pendent les années 1822, 1823, 1824, et 1825 . . . atlas, (1830) zoophytes, 16 pls.

1843. ———— Histoire Naturelle des Zoophytes. Acalèphes. Paris, pp. 8+596, atlas of 12 pls.

1893. LEVINSEN, G. M. R. Meduser, Ctenophorer og Hydroider fra Grønlands vest kyst. . . . Vid. Meddel. Nat. Hist. for Kjöbenhavn, ser. 5, vol. 4, pp. 143–212, pls. 5–8.

1899. LINKO, A. Observations sur les Méduses de la Mer Blanche. Trav. Soc. Imp. Nat., St. Pétersbourg, vol. 29, pp. 137–156, 1 pl.

1902. ———— Beiträge zur Kenntniss der Hydromedusen. Zool. Anz., vol. 25, pp. 162–164.

1758. LINNAEUS, C. von. Systema Naturæ . . . Ed. 10, vol. 1, 823 pp.

1893. MAAS, O. Die Craspedoten Medusen der Plankton-Expedition. Ergeb. der Plankton-Ex. der Humboldt-Stiftung, vol. 2, K. c., 107 pp., 6 pls. 2 maps.

1897. ———— Reports on an Exploration off the West Coasts of Mexico, etc. Die Medusen, Mem. Mus. Comp. Zoöl., Harvard Coll., vol. 23, 92 pp., 15 pls.

1903. ———— Die Scyphomedusen der *Siboga*-Expedition. Uitkom. op. Zool. Bot., Oceanogr. en Geol. Gebied. *Siboga*-Expeditie. Monogr. 11, pp. 91, 12 pls.

1904*a*. ———— Revision des Méduses appartenant aux Familles des Cunanthidae et des Aeginidae, et groupement nouveau des Genres. Bull. Mus. Océanographique de Monaco, No. 5, pp. 8.

1904*b*. ———— Méduses provenant des Campagnes des Yachts *Hirondelle* et *Princesse-Alice* (1886–1903). Résultats des Camp. Sci. etc. par Albert 1er, Prince Souverain de Monaco . . . fasc. 28, pp. 71, 6 pls.

1905. ———— Die Craspedoten Medusen der *Siboga*-Expedition. Uitkom. op. Zool. Bot., Oceanogr. en Geol. Gebied. *Siboga*-Expeditie. Monogr. 10, pp. 84, 14 pls.

1906*a*. ———— Medusen. Résultats du Voyage du. S. Y. *Belgica*, Rapports Scientifiques. pp. 30, 3 pls.

1906*b*. ———— Die Arktischen Medusen. Fauna Arctica, vol. 4, pp. 480–526.

1909. ———— Japanische Medusen. Beiträge zur Naturgeschichte Ostasiens . . . herausg. von Dr. F. Doflein. Abh. k. bayer. Akad. Wiss., 1 suppl. vol., 8 ab., pp. 52, 3 pls.

1910. ———— Contributions au Système des Méduses, basée sur des formes bathypélagique des Campagnes Scientifiques de S. A. S. Le Prince de Monaco. Bull. Inst. Océanographique, No. 183, pp. 11.

1856. MCCRADY, J. Description of Oceania (Turritopsis) nutricula, nov. spec., and the embryological history of a singular Medusan Larva found in the Cavity of its Bell. Proc. Elliott Soc., vol. 1, pp. 55–90, pls. 4–7.

1857. ———— Gymnophthalmata of Charleston Harbor. Proc. Elliott Soc., vol. 1, pp. 103–221, pls. 8–12.

1889. MCINTOSH, W. C. On the Pelagic Fauna of the Bay of St. Andrews during the months of 1888. Seventh Ann. Rep. Fishery Board of Scotland, pp. 259–310, pls. 3–6.

1900. MAYER, A. G. Some Medusae from the Tortugas, Florida. Bull. Mus. Comp. Zoöl., Harvard Coll., vol. 37, pp. 13–82, 44 pls.

1910. ———— Medusae of the World. 3 vols., pp. 734, 76 pls. Carnegie Inst., Washington, publ. No. 109.

1886. METSCHNIKOFF, E. Medusologische Mitteilungen. Arb. Zool. Inst. Wien, vol. 6, pp. 29, 2 pls.

1791. MODEER, ADOLPH. Nova Acta Phys. Med. Acad. Leop. Carol., vol. 8, appendix, p. 32.

Digitized by Google

1902. MURBACH, L., and SHEARER, C. Preliminary Report on a Collection of Medusae from the Coast of British Columbia and Alaska. Ann. Mag. Nat. Hist., ser. 7, vol. 9, pp. 71–73.

1903. ———. On the Medusae from the Coast of British Columbia and Alaska. Proc. Zool. Soc., London, Part 2, pp. 164–192, pls. 17–22.

1901. NUTTING, C. C. The Hydroids. Papers from the Harriman Alaska Expedition, No. 21. Proc. Washington Acad. Sci., vol. 3, pp. 157–216, pls. 14–26.

1823. OTTO, A. W. Beschreibung einiger neuer Mollusken und Zoophyten. Nova Acta Caes. Leop. Carol., vol. 11, pp. 273–314, pls. 38–42.

1807. PÉRON, F., et LESUEUR, C.-A. Voyage de Découvertes aux terres australes. . . . Paris, pp. 15+496, 41 pls.

1809. ———. Histoire Générale et Particulière de tous les Animaux qui composent la Famille des Méduses. Ann. Mus. Hist. Nat., vol. 14, pp. 218–228.

1827. QUOY et GAIMARD. Observations faites à bord de l'*Astrolabe* dans le détroit de Gibraltar. Ann. Sci. Nat., vol. 10, pp. 1–21, 172–193, pls. 1, 2, 4–6. Also Oken's Isis, vol. 21.

1834. ———. Zoologie; in Voyage de découvertes de l'*Astrolabe*, etc. . . . de M. J. Dumont D'Urville. Paris, vol. 4, pp. 390, Atlas Zool., vol. 2, Zoophytes, 26 pls.

1835. RATHKE, M. H. Beschreibung der Oceania Blumenbachii. . . . Mem. Acad. Imp. Sci. St. Pétersbourg, vol. 2, pp. 321–330, 1 pl.

1876. ROMANES, G. J. An Account of some New Species, Varieties, and Monstrous Forms of Medusae. Journ. Linn. Soc. London, vol. 12, pp. 524–531.

1877. ———. An Account of some New Species, Varieties, and Monstrous Forms of Medusae. Journ. Linn. Soc. London, vol. 13, pp. 190–194, pls. 15, 16.

1899. SAEMUNDSSON, B. Zoologiske Meddelelser fra Island. V, Auliscus pulcher. Vid. Medd. Nat. Hist., For. Kjobenhavn, ser. 6, pp. 425–427, pl. 4.

1835. SARS, M. Beskr- og Jattagelser, etc. Bergen, pp. xii+82, 15 pls.

1846. ———. Fauna Littoralis Norvegiæ, 1, pp. 94, 10 pls.

1898. SCHNEIDER, K. C. Mittheilungen uber Siphonophoren. III. Zool. Anz., vol. 21, pp. 51–57, 73–95, 114–133, 153–173, 185–200.

1837. STEENSTRUP, J. J. S. Acta et Catalogus Musei Hafniensis. Hauniae.

1905. TORREY, H. B. The Hydroids of the Pacific Coast of North America. Univ. of Cal. Publ., Zool., vol. 1, pp. 1–82, 11 pls.

1909. ———. The Leptomedusae of the San Diego Region. Univ. of Cal. Publ., Zool., vol. 6, No.2, pp. 11–31.

1902*a*. VANHÖFFEN, E. Die Acraspeden Medusen der Deutschen Tiefsee-Expedition, 1898–1899. Wiss. Erg. der Deutschen Tiefsee-Expedition, vol. 3, pp. 1–52, pls. 1–8.

1902*b*. ———. Die Craspedoten Medusen der Deutschen Tiefsee-Expedition, 1898–1899. 1. Trachymedusen. Wiss. Erg. der Deutschen Tiefsee-Ex., vol. 3, pp. 53–88, pls. 9–12.

1906. ———. Acraspedae. Nordisches Plankton, Lief. 5, Teil. 11, pp. 40–64, 37 figs.

1908. ———. Die Narcomedusen. Wiss. Erg. Deutschen Tiefsee-Expedition, vol. 19, pp. 43–74, pls. 7–9.

1911. ———. Die Anthomedusen und Leptomedusen. Wiss. Erg. der Deutschen Tiefsee-Expedition, vol. 19, Heft 5, pp. 192–233, pl. 22.

1869. VERRILL, A. E. Description of a Remarkable New Jelly-Fish and Two Actinians from the Coast of Maine. Amer. Journ. Sci., ser. 2, vol. 48, pp. 116–118. Ann. Mag. Nat. Hist., ser. 4, vol. 4, p. 161.

1854. VOGT, C. Sur Les Siphonophores de la Mer de Nice. Mem. Inst. Geneva, vol. 1, pp. 1–164, 21 pls.

Digitized by Google

EXPLANATION OF PLATES.

PLATE 1.

Meator rubatra.

Fig. 1. Side view of type. ×3.
2. Oral view of same.
3. Side view of manubrium of another specimen.

Catablema multicirrata.

Fig. 4. Side view of specimen, 29 mm. high, with the bell opened and its walls turned aside to show the manubrium.
5. Radial canal and portion of margin.
6. Dissection of margin, showing bases of an old and a young tentacle in side view.
7. Portion of margin.

Catablema vesicaria, VAR. *noduloea.*

Fig. 8. Side view of specimen 21 mm. in diameter, with part of the bell wall dissected away to show manubrium and gonads.
9. Similar dissection of a young specimen 10 mm. in diameter.

PLATE 2.

Pandea rubra.

Fig. 1. Side view of type, 47 mm. high.
2. Upper part of another specimen, with part of the bell wall cut away to show manubrium and gonads.
3. Radial canal and portion of margin.
4. Side view of base of a tentacle.
5. Portion of radial canal.
6. Young specimen, 27 mm. high.
7. Manubrium of same.

Calycopsis nemataphora.

Fig. 8. Type, with part of bell wall cut away to show manubrium. ×3.

PLATE 3.

Calycopsis nematophora.

Fig. 1. Margin.
2. Aboral view of subumbrella, with manubrium largely cut away to show its relation to the canals.
3. Portion of lip.

Pantachogon haeckeli.

Fig. 4. Side view of specimen, 17 mm. in diameter.
5–7. Successive stages in the development of the gonads.
8. Manubrium and proximal part of gonads of a large specimen.

Crossota alba.

Fig. 9. Side view of type. × about 3.
10. Portion of margin of same, showing stumps of tentacles of different ages.
11. Portion of inner surface of bell of another specimen to show manubrium and gonads.
12. Sense-club of same. ×75.

Digitized by Google

Crossota pedunculata.

Fig. 13. Portion of type showing manubrium with its peduncle, and one gonad. ×3.

PLATE 4.

Botrynema ellinorae.

Fig. 1. Slightly oblique side view of specimen, 13 mm. in diameter.
2. Portion of margin of same to show stumps of tentacles.
3. Portion of same, more highly magnified, to show sense-clubs.
4. Sense-club.

Cyanea capillata, var. *nozakii.*

Fig. 5. Portion of subumbrella, about natural size.
6. Rhopalium of same, in side view.
7. Aboral view of rhopalium.

Cyanea capillata var. *capillata.*

Fig. 8. Portion of subumbrella.
9. Rhopalium of same, side view.

Phacellophora ambigua.

Fig. 10. Portion of subumbrella and margin.

PLATE 5.

Aurelia limbata.

Fig. 1. Portion of subumbrella of large specimen, 200 mm. in diameter, showing the canal system.
2. Aboral view of rhopalar folds and niche of same.
3. Dissection of margin, showing the rhopalium in side view.
4. Segment of subumbrella of a young specimen, 20 mm. in diameter.

Phacellophora ambigua.

Fig. 5. Dissection of margin, showing rhopalium in side view.

Galeolaria australis.

Fig. 6. Apex of lower and base of upper bell, with base of stem, to show the method of association. ×10.

Vogtia pentacantha.

Fig. 7. Mature nectophore, 16 mm. broad.
8. Young nectophore, 4 mm. broad.
9. Nectophore, 8 mm. broad at a stage intermediate between figs. 7 and 8.

Rosacea plicata.

Fig. 10. Side view of nectophore and contracted stem of specimen from the northwestern Pacific. ×2.5.
11. Extremity of somatocyst of specimen from the Bay of Biscay.

PLATE 6.

Clausophyes galatea.

Fig. 1. Entire animal. ×3.
2. Base of superior and apex of inferior nectophore of another specimen to show their relationship to the stem.

Digitized by Google

Diphyes truncata.

Fig. 3. Inferior nectophore; the course of the lateral subumbral canals is partly reconstructed (dotted). ×7.

4. Ventral view of base of same to show basal wings and open hydroecial groove bounded by two ridges.

5. Ventral view of base of superior nectophore. (See text fig. 2, p. 74.)

Vogtia pentacantha.

Fig. 6. Part of a colony with the nectophores torn off to show the relationship between the muscular stalk or "Knospungzone," which bears the latter to the stem. At its tip are four young nectophores. Only the basal part of the stem, with a few siphons and gonophores, is shown.

Archangelopsis typica.

Fig. 7. Side view. ×4. From a photograph.

Digitized by Google

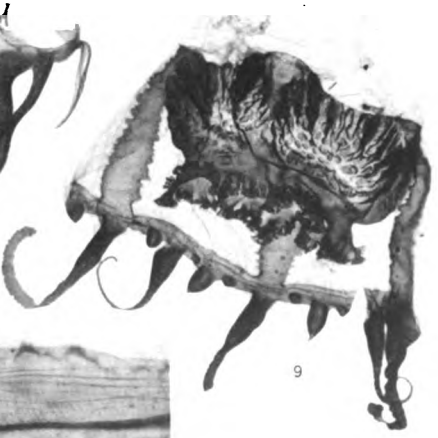
Digitized by Google

1

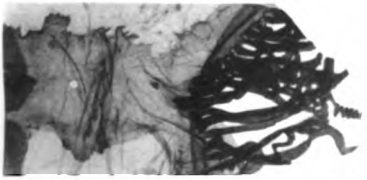
2

3

6



9



5

7

8

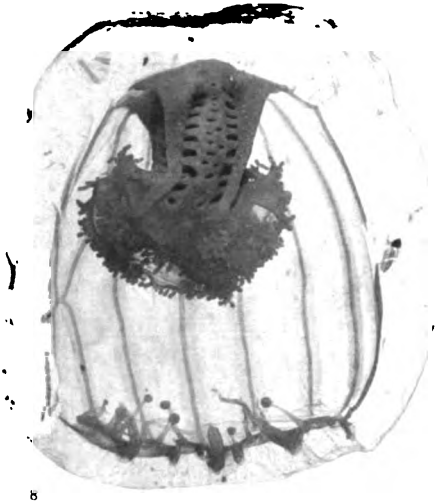
4

ANTHOMEDUSAE

FOR EXPLANATION OF PLATE SEE PAGE 117

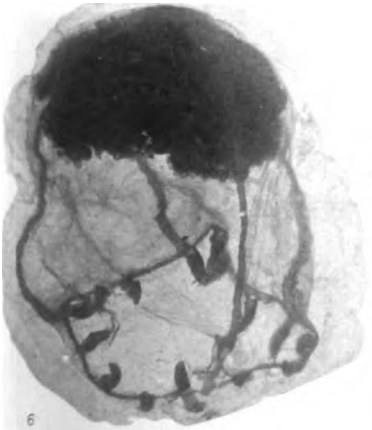
Digitized by Google

Digitized by Google



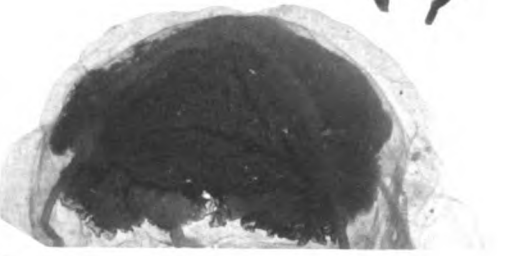
8

1

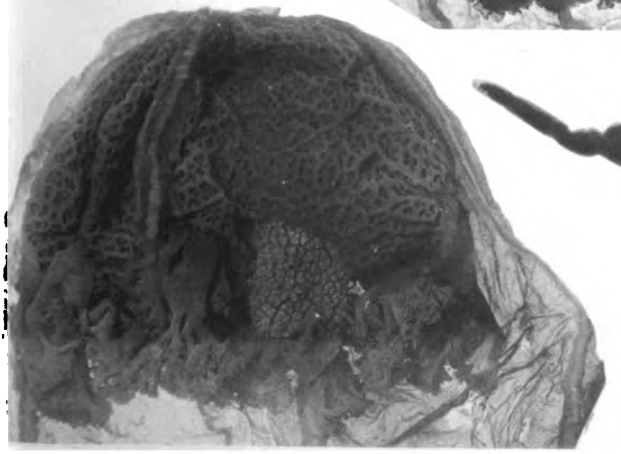


6

3

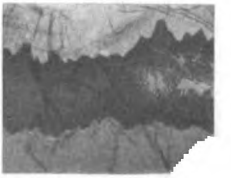


7



2

4



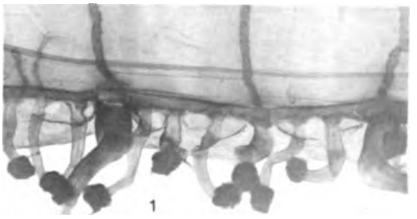
5

ANTHOMEDUSAE

FOR EXPLANATION OF PLATE SEE PAGE 117

Digitized by Google

Digitized by Google


1

4

2

6

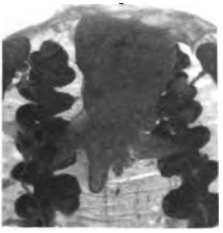
7

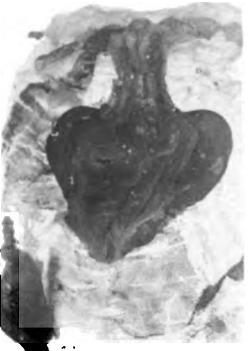
12

5

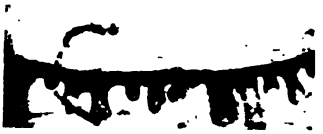
3

11


8


13

9

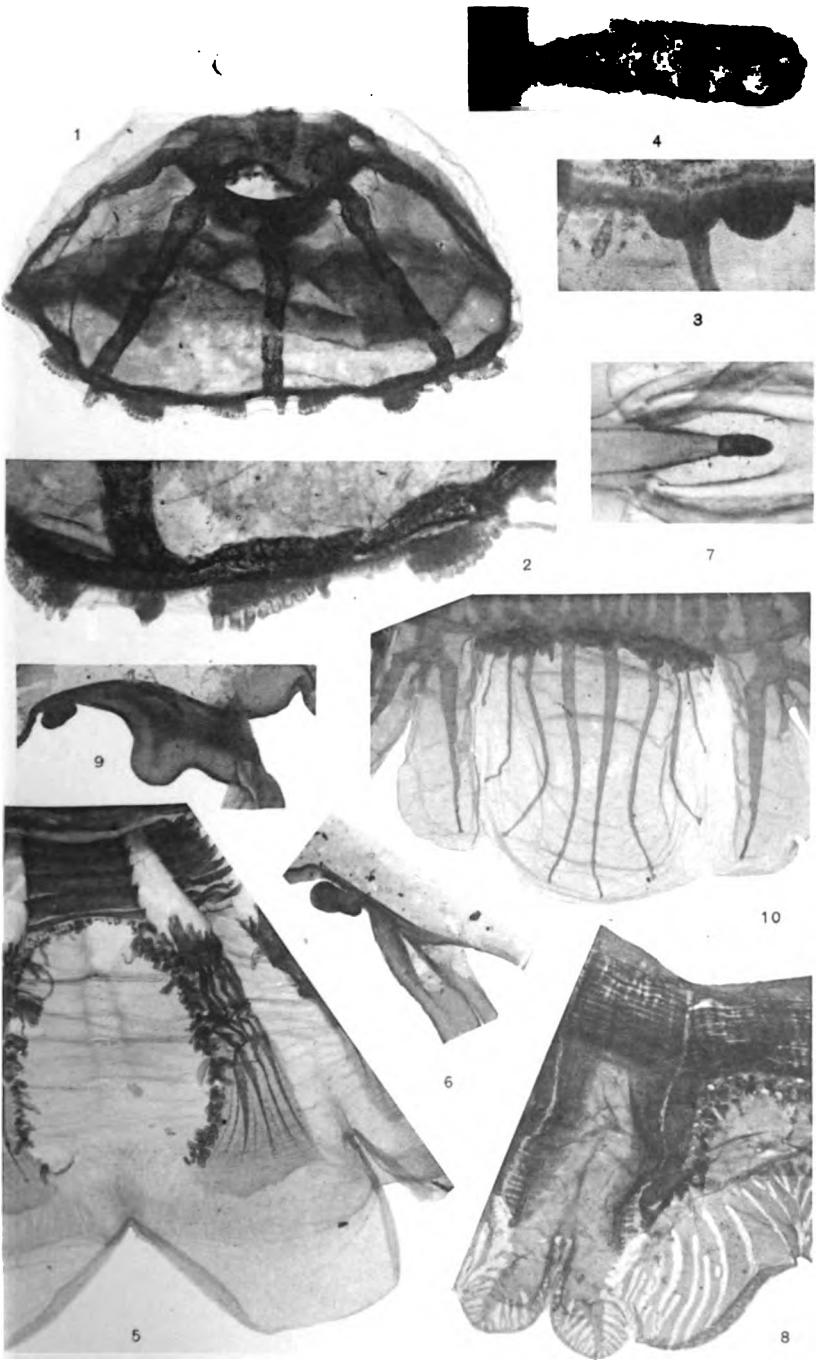

10

ANTHOMEDUSAE AND TRACHOMEDUSAE

FOR EXPLANATION OF PLATE SEE PAGES 117 AND 118

Digitized by Google

Digitized by Google



TRACHOMEDUSAE AND SCYPHOMEDUSAE

FOR EXPLANATION OF PLATE SEE PAGE 118

Digitized by Google

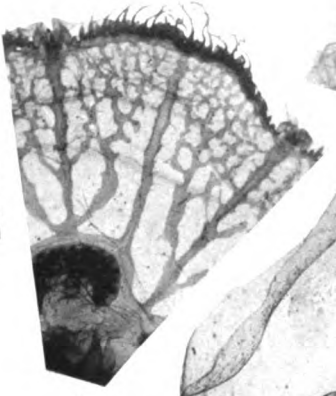
Digitized by Google

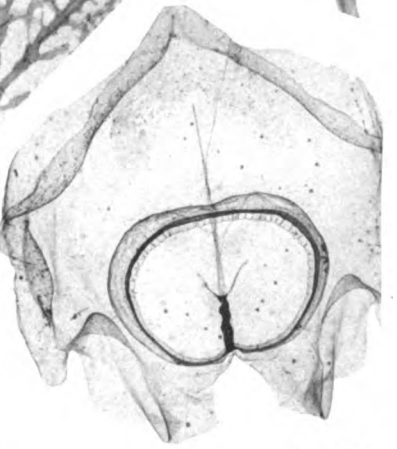
1

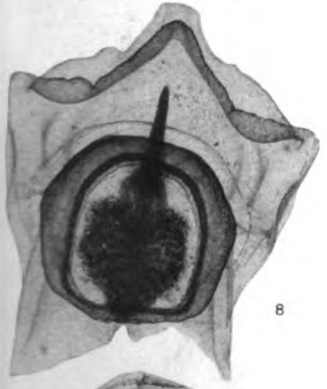
3

2

5


4

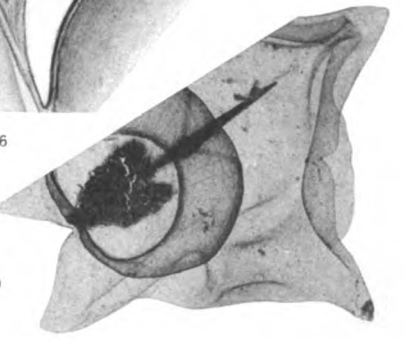

7


8

6

11

10

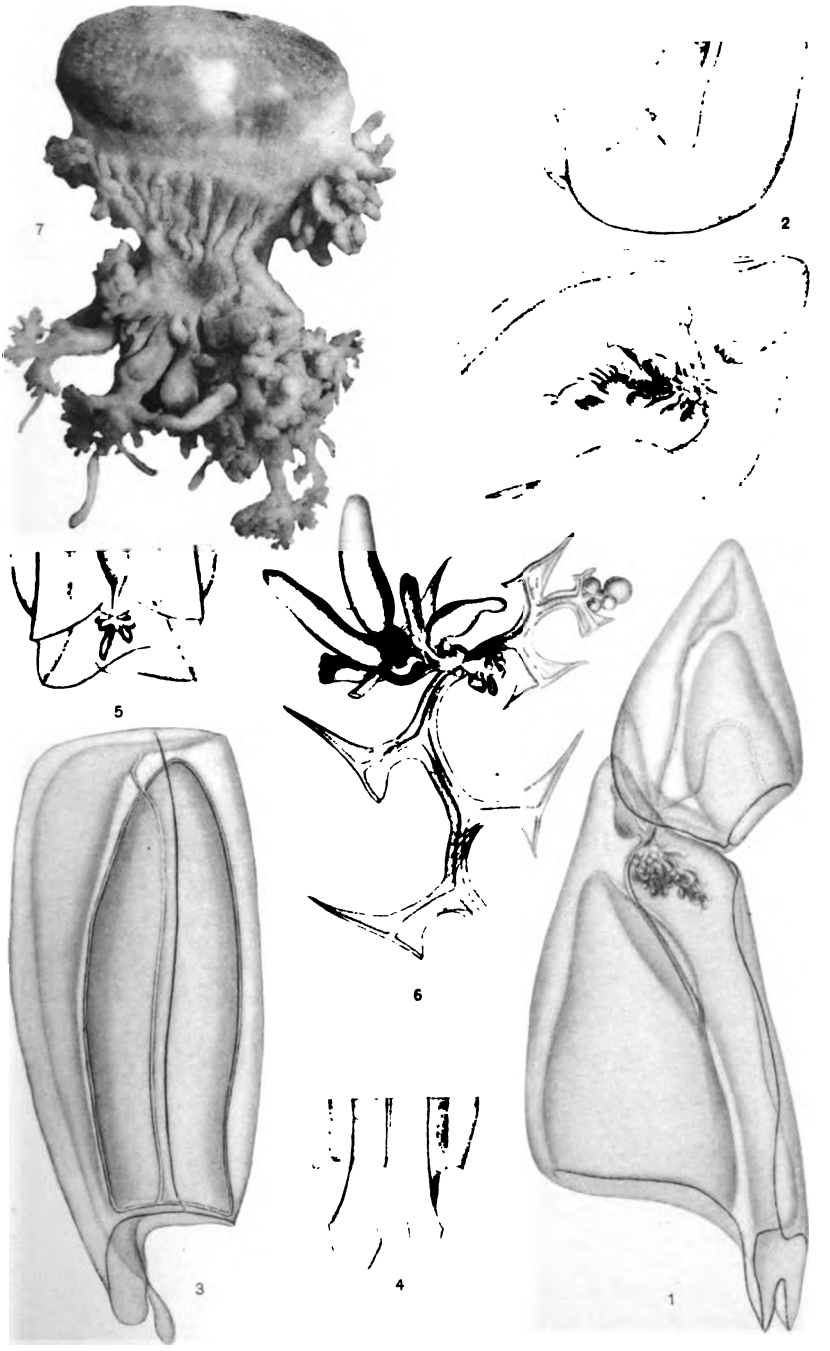

9

SCYPHOMEDUSAE AND SIPHONOPHORAE

Digitized by Google

FOR EXPLANATION OF PLATE SEE PAGE 118

Digitized by Google



SIPHONOPHORAE

FOR EXPLANATION OF PLATE SEE PAGES 118 AND 119

Digitized by Google

Digitized by Google

DESCRIPTIONS OF NEW SPECIES OF SATURNIAN MOTHS IN THE COLLECTION OF THE UNITED STATES NATIONAL MUSEUM.

By HARRISON G. DYAR,
Custodian of Lepidoptera, United States National Museum.

The present paper deals with species of the genus *Hylesia* belonging to the family Saturniidæ.

Genus HYLESIA Hübner.

Hylesia HÜBNER, Verz. bek. Schmett., 1822, p. 186. Type, *canitia* Stoll.
Micrattacus WALKER, Cat. Lep. Brit. Mus., vol. 6, 1855, p. 1335. Type, *nanus* Walker.

Table of species.

a^1 Hind wing, at least in the male, with ocellate discal mark.
b^1 Fore wing of male strongly falcate; female very dissimilar.....*nanus* Walker.
b^2 Fore wing of male not strongly falcate.
c^1 Ocellus of hind wing of male brick red with yellow center..*corevia* Schaus.
c^2 Ocellus red with black or crimson ring.
d^1 Hind wing of male with blunt projection below middle of outer margin. *lineata* Druce.
d^2 Hind wing of male nearly evenly curved.
e^1 Ocellus of hind wing of male with black ring....*subaurea* Schaus.
e^2 Ocellus of hind wing of male with dull crimson ring....*iola* Dyar.
a^2 Hind wing of male without ocellate discal mark, at most a diffused darker patch.
b^1 Hind wing of male with projecting angle below middle.
c^1 Abdomen rosy.....*æneides* Druce.
c^2 Abdomen ocherous.
d^1 Fore wing with large blackish discal patch. *melanostigma* Herrich-Schaeffer.
d^2 Fore wing without this marking.....*gyrex* Dyar (1).
b^2 Hind wing of male evenly rounded.
c^1 Fore wing of male roundedly produced at apex; a brown band on basal part of inner margin oblique to the base.
d^1 Outer band of fore wing distinct, dark, broad.....*mymex* Dyar (2).
d^2 Outer band absent, faint, or very slender.
e^1 Fore wing of male without distinct discal mark; thorax black.
f^1 Fore wing rosy brown.....*acuta* Druce.
f^2 Fore wing dark smoky brown.
g^1 Venter of thorax and abdomen sooty brown.
h^1 Fore wing with faint outer line.....*hamata* Schaus.
h^2 Fore wing with outer line obsolete...*tapareba* Kirby

Digitized by Google

g^2 Pectus and venter reddish, bordered with gray.
tapabex Dyar (3).

e^2 Fore wing of male with large dark discal mark; thorax yellow brown. *rosacea* Schaus.

c^2 Fore wing of male little or not produced at apex; no brown band on base of inner margin.

d^1 Fore wing of male with annular discal mark.

e^1 Feet rosy red ..... *rufipes* Schaus.

e^2 Feet ocherous or blackish.

f^1 Abdomen black dorsally ..... *annulata* Schaus.

f^2 Abdomen ocherous ..... *ochrifex* Dyar (4).

f^3 Abdomen dark brown throughout ..... *index* Dyar (5).

d^2 Discal mark of fore wing of male clouded, solid, or obsolete.

e^1 Feet rosy red or rosy tinged.

f^1 Wings pale rosy; abdomen black dorsally... *margarita* Dognin.

f^2 Wings brown; abdomen not black dorsally.

g^1 Hind wing with ocherous tint at base of inner margin.
dalina Schaus.

g^2 Hind wing without such tint, more or less rosy.

h^1 Abdomen of male with ocherous hairs dorsally.

i^1 Outer band of fore wing of male shaded outward toward subterminal line .... *rubrifrons* Schaus.

i^2 Outer band not so shaded, though sometimes lost in the general suffusion.

j^1 Female with the lateral and terminal abdominal tufts dark brown; male larger, fore wing falcate, marks contrasting... *alinda* Druce.

j^2 Female with lateral and terminal abdominal tufts black; male smaller, fore wing a little less falcate, marks contrasting.
cressida Dyar (29).

j^3 Female with the abdominal tufts ocher; male smaller; fore wing scarcely falcate, marks blurred ..... *euphemia* Dyar (30).

h^2 Abdomen of male with rosy brown hairs only, like the thorax ..... *multiplex* Schaus.

e^2 Feet without any rosy tint.

f^1 Lines of fore wing appearing dark on a paler ground.

g^1 Outer line of fore wing broad, shaded, illy defined or nearly lost in the ground color.

h^1 Outer line broad, shaded.

i^1 Hind wing of male with the two lines alike, joined by shading, forming a broad dark band.
pollex Dyar (6).

i^2 Hind wing of male with the two lines alike, remote, separated ..... *valvex* Dyar (7).

i^3 Hind wing of male with the inner line heavier and more distinct than the outer.. *umbrata* Schaus.

h^2 Outer line not of this character, but nearly lost in the general dark shading.

i^1 Male unknown ..... *terranea* Schaus.

i^2 Male with the two outer lines of hind wing near the margin, fairly distinct, their pale interspaces giving the appearance of two pale lines.
murex Dyar (8).

Digitized by Google

i^2 Male with the lines of hind wing very indistinct, more remote from the margin and without contrasting interspaces.

j^1 Fore wing below smooth mouse gray, the veins concolorous.....*ascodex* Dyar (9).

j^2 Fore wing below rough gray, blotched with blackish; veins dark lined. *leilex* Dyar (10).

g^2 Outer line of fore wing distinct, straight, more or less narrow and not diffused.

h^1 Abdomen of male black above, gray below, the anal tuft pale ocherous.....*murmur* Dyar (11).

h^2 Abdomen of male with numerous dark ocherous hairs at least on sides and venter.

i^1 Discal spot predominant, large and distinct, while the other markings are slender and reduced. *indurata* Dyar.

i^2 Discal spot not predominant, though often large.

j^1 Outer line on fore wing of male broad.

k^1 Inner line of hind wing of male crossing the discal venules; no discal mark.

l^1 Male with the abdomen black dorsally.....*oratex* Dyar (12).

l^2 Abdomen with ocherous hairs dorsally.

m^1 Outer line on hind wing crenulate, defining a pale lilacine submarginal space. *cozx* Dyar (13).

m^2 Outer line of hind wing shaded; no lilacine ground. *rex* Dyar (14).

k^2 Inner line of hind wing of male passing without the discal venules.

l^1 Hind wing with large discal spot. *orbifex* Dyar (15).

l^2 Hind wing with slender mark on discal venules, or none.

m^1 Submarginal space of fore wing in male distinctly marked, the pale lilacine shade sharply defined and broken before apex.

n^1 Lines of hind wing slender, parallel; no discal mark. *remex* Dyar (16)

n^2 Lines of hind wing broader, the outer subcrenulate; a faint narrow discal mark. *livex* Dyar (17).

m^2 Submarginal space of fore wing indistinctly marked, the pale lilacine shade diffused, not broken before apex.

Digitized by Google

m¹ Fore wing with broader outer band, shading outwardly. *liturex* Dyar (18).

m² Fore wing with narrower band, sharply defined without.....*molpex* Dyar (19).

j² Outer line on fore wing of male narrow, linear.

k¹ Wings lilacine tinted.

l¹ Outer line of fore wing straight; hind wing subtriangular. *falcifera* Hübner.

l² Outer line broadly inflexed; hind wing full, rounded....*mortifex* Dyar (20).

k² Wings brown tinted.

l¹ Hind wing beneath with the lines straight, approximate, the inner stronger than the outer. *nigricans* Berg.

l² Hind wing beneath with the lines similar to each other, faint, remote, curved.....*lolamex* Dyar (21).

f² Lines of fore wing appearing pale on a dark ground.

g¹ Abdomen of male with dark ocherous hairs dorsally.

h¹ Fore wing rosy.

i¹ Outer and submarginal lines of fore wing indicated. *coinopus* Dyar.

i² Outer and submarginal lines lost; discal mark prominent.....*continua* Walker.

h² Fore wing without predominant rosy tint.

i¹ Subterminal pale shade as prominent as the other lines.

j¹ Hind wing appearing to have two curved dark lines on a paler ground.

k¹ Abdomen of male with dense ocher hairs.

l¹ Abdomen of female dark with few ocher hairs.

m¹ Wings distinctly marked; size larger.....*canitia* Stoll.

m² Wings indistinctly marked; size smaller.....*inficita* Walker.[1]

l² Abdomen of female densely ocher-haired like the male. *schausi* Dyar (22).

k¹ Abdomen of male gray with very few ocher hairs.....*pauper* Dyar (23).

j² Hind wing appearing to have a single curved pale line on a dark ground, or unbanded.

k¹ Discal mark of fore wing clouded, dark, visible; hind wing with single pale band.

[1] As identified by Schaus from Costa Rican specimens. Probably not the true *inficita* Walker from Brazil.

Digitized by Google

l^1 Smaller; costa of fore wing dark-blotched; wings narrower; abdominal hairs dark ocher.
mystica Dyar (24).
l^2 Larger; costa of fore wing concolorous; wings broader and more rounded; abdominal hairs brown, scarcely ocherous.....*athlia* Dyar (25).
k^2 Discal mark of fore wing invisible, concolorous; hind wing with only the margin paler.....*cedomnibus* Dyar (26).
i^2 Subterminal pale shade faint, subordinated.
j^1 Pale lines of fore wing relieved on a dark ground without bordering shades, somewhat approximate below.....*vindex* Dyar (27).
j^2 Pale lines of fore wing with inner blackish bordering shades, strongly approximated below.....*solvex* Dyar (28).
g^2 Abdomen of male without ocherous hairs dorsally.
h^1 Abdomen with lateral and ventral ocherous hairs.
frigida Schaus.
h^2 Abdominal hair entirely black.....*bouvereti* Dognin.

(1) HYLESIA GYREX, new species.

Male.—Fore wing rather strongly falcate, pointed at end of vein 7; hind wing with a rounded projection of outer margin between veins 3 and 4; brown, like *melanostigma* Herrich-Schaeffer; two brown lines across the wing, similar, but more approximate; a slender dash on discal vein; submarginal line as in *melanostigma*. Hind wing with a single line beyond the middle and a faint submarginal line, the pair much farther apart than in *melanostigma;* no discal mark; inner margin darkly shaded and hairy. Expanse, 57 mm.

Type.—Male, Omai, British Guiana (W. Schaus), Cat. No. 14959, U.S.N.M.

(2) HYLESIA MYMEX, new species.

Male.—Head and thorax black; abdomen black above, with longer reddish brown hairs, reddish brown below, the feet with darker outer hairs. Fore wing rather shortly falcate, hind wing rounded; fore wing purplish brown, apex broadly fuscous shaded; a dark brown band at base of inner margin; a weak bar on discal cross vein and small mark in the cell; outer line parallel to margin, blackish brown, rather broad. Hind wing with mesial shaded band. Expanse, 39 mm.

Type.—Male, Colombia (W. E. Pratt), Cat. No. 14960, U.S.N.M.

(3) HYLESIA TAPABEX, new species.

Male.—Head, thorax, and first abdominal segment black above; abdomen ocher brown; below pectus and venter ferruginous, legs and sublateral stripe on abdomen gray-brown. Fore wing falcate, sooty

Digitized by Google

brown, lighter toward base; discal mark pale with central dot; outer line faint, dark. Hind wing with faint mesial shade and discal dot. Expanse, 42 mm.

Female.—Thorax above and legs purplish brown; abdomen and thorax below ocher brown; wings purplish brown, fore wing with angled tips, but not falcate; dark at base to inner line; rather large discal spot; outer line broad, straight, diffused; subterminal line waved on its outer side, diffused within. Hind wing with two parallel dusky bands. Expanse, 55 mm.

Cotypes, one male, one female, Calamar, Colombia (H. Skinner); two males, two females, Aroa, Venezuela (Schaus collection), Cat. No. 14961, U.S.N.M.

(4) HYLESIA OCHRIFEX, new species.

Male.—Thorax dark gray, abdomen and venter ocherous, the abdomen with dorsal brown banding. Fore wing square at apex, hardly falcate, the markings as in *annulata* Schaus, with the following differences: Discal mark smaller, its annulus narrower and less clouded; dark area at base less black, with more included pale spots; outer line less curved. Expanse, 44 to 48 mm.

Cotypes.—Three males, Rio Huacamaya, Carabaya, Peru (Schaus collection), Cat. No. 14962, U.S.N.M.

(5) HYLESIA INDEX, new species.

Male.—Fore wing square at apex, not falcate; body parts all dark sooty brown; fore wing with purplish cast, especially toward center of inner margin, the lines parallel, dark brown, straight, fading toward the costa; subterminal line doubly dentate between the veins as in *annulata* Schaus and *ochrifex* Dyar; discal mark clouded, indistinct, hardly annular, but showing a dark line on the cross vein of cell and inner dark line. Hind wing with two outer dark lines, the submarginal one somewhat irregular. Expanse, 43 mm.

Cotypes.—Four males, Rio Huacamaya, Carabaya, Peru (Schaus collection), Cat. No. 14963, U.S.N.M.

(6) HYLESIA POLLEX, new species.

Male.—Thorax dark brown-gray; abdomen with dark ocherous hairs. Fore wing lilacine gray; basal space filled in with dark brown; discal mark large, clouded; outer band broad, shaded, indistinctly separated by a lighter space from the wavy subterminal band, which is shaded inward; fringe dark. Hind wing with discal mark; the two outer bands approximated and shaded together into one broad band with lighter center. Expanse, 37 to 40 mm.

Female.—Similar, the markings more diffused and shaded. Expanse, 48 to 52 mm.

Digitized by Google

Cotypes.—Six males, five females, Aroa, Venezuela (Schaus collection), Cat. No. 14964, U.S.N.M.

One of the females has been labeled by Mr. Schaus "*approximans* Walk., comp. type." (See remark under *H. valvex* below.)

(7) HYLESIA VALVEX, new species.

Male.—Larger than the preceding, the subterminal line of fore wing scarcely at all wavy, broadly shaded to the outer band. Hind wing with the two lines remote, evenly shaded, but not joined. Expanse, 47 to 50 mm.

Female.—Still more diffusely shaded, the outer and subterminal lines of fore wing joined in a broad band, not separated as in *pollex*. Expanse, 62 mm.

Cotypes.—Four males, two females, St. Jean and St. Laurent, Maroni River, French Guiana, March, April, and November, 1904 (W. Schaus), Cat. No. 14965, U.S.N.M.

One of the females is labeled by Mr. Schaus "*approximans* Walker = female type;" but as he has similarly labeled *pollex*, described above, and *schausi*, described below, and as *approximans* Walker was described from Brazil, I think it probable that it represents a species distinct from all of these.

(8) HYLESIA MUREX, new species.

Male.—Fore wing pointed, subfalcate; thorax gray; abdomen with dull ocherous hairs. Fore wing dark mouse-gray, the lines nearly obliterated; discal spot dark; subterminal line apparently scalloped and broadly shaded toward the outer line. Hind wing with the two outer lines relieving outer and submarginal paler areas. Expanse, 32 mm.

Type.—One male, Geldersland, Surinam River, Dutch Guiana (W. Schaus), Cat. No. 14966, U.S.N.M.

(9) HYLESIA ASCODEX, new species.

Male.—Smooth mouse-gray above and below, the abdomen with dark ocherous hairs. Fore wing with a large, faint, discal dot and traces of the scalloped outer edge of subterminal line. Hind wing with two faint dark outer bands, not relieving a lilacine ground. Expanse, 40 mm.

Cotypes: Three males, Rio Huacamaya, Carabaya, Peru (Schaus collection), Cat. No. 14967, U.S.N.M.

(10) HYLESIA LEILEX, new species.

Similar to the preceding, but more shaded with blackish, the veins darker lined; discal spot large, round, dark; irregular blotchings represent the subterminal line. Hind wing without distinguishable lines, the veins darker. Expanse, 40 mm.

Digitized by Google

Type.—One male, Rio Huacamaya, Carabaya, Peru (Schaus collection), Cat. No. 14968, U.S.N.M.

(11) HYLESIA MURMUR, new species.

Male.—Head, thorax, and legs clothed with deep black hair; anal tuft pale brownish ocher. Fore wing square at apex, lilacine gray; base shaded dark to inner line, which is angled in the cell; discal mark present; outer line thick, distinct, incurved centrally, touching the discal mark; a fainter parallel line beyond; subterminal line coincident with the second outer line above, faint and forming two broad rounded projections between veins 2 and 4 below; a dark shade on margin, widening above. Hind wing darker gray with two outer parallel darker bands; no discal mark. Expanse, 46 mm.

Type.—One male, Santo Domingo, Peru (Schaus collection), Cat. No. 14970, U.S.N.M.

Apparently nearly allied to *H. nigridorsata* Dognin [1] which is autoptically unknown to me. *H. praeda* Dognin [2] is apparently of this same type, with the outer line even more bent.

(12) HYLESIA ORATEX, new species.

Male.—Thorax and abdomen black above with very few ocher hairs; sides and venter brown, mixed with ocher, anal tuft ocher. Fore wing dark lilacine gray, the markings well relieved; base diffusely dark-shaded; two rounded discal dots, one in the cell, one at the end; outer line straight, moderately broad, followed by a dense shading to outer line, which is irregular, projecting in the interspaces 2–3 and 3–4; a broad marginal shade on upper half of outer margin. Hind wing darkly shaded, the inner line running close to end of cell or crossing lower angle of discal venules, the outer faint, half way to the margin. Expanse, 36 mm.

Female.—Similarly marked, but more diffusely; hind wing with inner band passing beyond end of cell; abdomen with dense lateral and terminal tufts of golden ocher hairs. Expanse, 50 mm.

Cotypes.—Two males, Castro, Parana, Brazil (Schaus collection); one female, Novo Friburgo, Brazil (Schaus collection); one female, Rio Janeiro, Brazil (Schaus collection), Cat. No. 14971, U.S.N.M.

(13) HYLESIA COËX, new species.

Male.—Thorax brownish gray; abdomen with dark ocher hairs. Fore wing lilacine gray, the base irregularly dark shaded to the inner line; a discal mark in cell and one at end; outer line straight, followed by dark shading to the irregular subterminal line; a dark shade on upper half of outer margin. Hind wing of the same color as fore wing, the central line curved, close to or crossing the discal

[1] Mém. Soc. Ent. Belg., vol. 19, 1912, p. 152. [2] Ann. Soc. Ent. Belg., vol. 45, 1901, p. 306.

Digitized by Google

venules; outer line slightly irregular, shaded, faint. Expanse, 30 to 32 mm.

Cotypes.—Five males, Aroa, Venezuela (Schaus collection), Cat. No. 14972, U.S.N.M.

(14) HYLESIA REX, new species.

Male.—Like the preceding, but the fore wing rather more falcate and much darker; outer discal mark only distinct; outer line broader, the following shade illy defined. Hind wing also dark, the lines poorly relieved. Expanse, 35 mm.

Type.—One male, St. Jean, Maroni River, French Guiana, April, 1904 (W. Schaus), Cat. No. 14973, U.S.N.M.

(15) HYLESIA ORBIFEX, new species.

Thorax brown-gray; abdomen thickly clothed with ocher hairs, the brown ground showing only on dorsum. Fore wing like *oratex*. Hind wing with a large discal mark, the two lines well beyond it, alike in shade, but the outer much wider than the inner. Expanse, 38 mm.

Type.—One male, Rio Janeiro, Brazil (Schaus collection), Cat. No. 14974, U.S.N.M.

(16) HYLESIA REMEX, new species.

Thorax dark gray; abdomen with dull ocher hairs. Fore wing lilacine gray, nearly clear of shading to outer line; discal mark elliptical, dark; outer line straight, distinct, the following shading narrow and straighter than usual, rather evenly waved; marginal shade even from apex to vein 3. Hind wing clear of shading basally and without discal mark; two lines far out, parallel, the outer broader and fainter than the inner. Expanse, 37 mm.

Type.—One male, Rio Janeiro, Brazil (Schaus collection), Cat. No. 14975, U.S.N.M.

(17) HYLESIA LIVEX, new species.

Male.—Like *oratex*, but the thorax brown-gray, not black, the abdomen with ocher hairs dorsally. Fore wing like *oratex*, the marks well contrasted. Hind wing with the lines passing beyond the cell, approximate, alike in shade, the outer broadened and a little irregular. Expanse, 36 mm.

Female.—Similar, the markings more diffused; thorax and abdomen brown, the latter with lateral and terminal dark ocher tufts. Expanse, 48 mm.

Cotypes.—Two males, three females, Rio Janeiro, Brazil (Schaus collection), Cat. No. 14976, U.S.N.M.

This may be *H. subcana* Walker, described from a female, but it is impossible to be sure from the description.

Digitized by Google

(18) HYLESIA LITUREX, new species.

Male.—Like *livex*, but smaller and less contrastingly marked; outer line less defined, nearly continuous with the submarginal shading. Lines of hind wing less relieved, less approximate, the outer running nearer the margin. Expanse, 33 to 35 mm.

Cotypes.—Five males, 60 miles up the Maroni River, French Guiana, August, 1904 (W. Schaus), Cat. No. 14977, U.S.N.M.

(19) HYLESIA MOLPEX, new species.

Entirely similar to *H. rex*, except that the inner line of hind wing runs slightly beyond the discal mark, which is faintly shown. Expanse, 35 mm.

Type.—One male, St. Jean, Maroni River, French Guiana, July, 1904 (W. Schaus), Cat. No. 14978, U.S.N.M.

Probably but a variation of *H. rex* Dyar.

(20) HYLESIA MORTIFEX, new species.

Male.—Thorax deep brown; abdomen with ocher hairs, banded on the segments. Fore wing slightly falcate, lilacine gray, heavily shaded with dark gray; a whitish powdering on costa near middle; discal mark large, clouded; outer line slender, hardly linear, slightly incurved centrally; subterminal shading scalloped below; marginal shade present above vein 4. Hind wing with two mesial lines shaded, the outer scalloped. Expanse, 35 mm.

Type.—One male, Aroa, Venezuela (Schaus collection), Cat. No. 14979, U.S.N.M.

(21) HYLESIA LOLAMEX, new species.

Male.—Brown, like *nigricans* Berg, but fore wing more falcate, discal mark larger, clouded, browner, the outer line browner and less rigid; subterminal shading browner and less defined. Hind wing brown like fore wing, the lines curved, brown, similar in shade. Beneath the hind wing has two faint remote curved similar bands, not with a strong, straight, inner one as in *nigricans*. Expanse, 35 mm.

Type.—One male, Aroa, Venezuela (Schaus collection), Cat. No. 14980, U.S.N.M.

(22) HYLESIA SCHAUSI, new species.

Lilacine gray, more rosy in the female. Fore wing squarely pointed, not falcate; abdomen densely clothed with ocher hairs in both sexes. Lines pale, converging to inner margin, the outer with a dark border within it, touching the discal clouded mark; terminal space pale, defined by a scalloped shade; a dark shade on the upper half of the outer margin, leaving a pale spot at tip. Hind wing with two curved outer dark lines, parallel, similar; no discal dot in the

Digitized by Google

male, a faint one in the female. Expanse, male 40 mm.; female 53 mm.

Cotypes.—Three females, Aroa, Venezuela (Schaus collection), Cat. No. 14982, U.S.N.M. Also five males, which are not made types on account of the uncertainty of associating the sexes in this genus. One of the males is labeled "*approximans* Walk.," another "*inficita* Walk." (See remark under *valvex*.)

(23) HYLESIA PAUPER, new species.

Male.—Fore wing narrow, subfalcate; all pale mouse-gray, the lines whitish gray; a blotch in the cell and one at apex, quite distinct; discal mark darker, clouded; shade on upper half of outer margin also dark. Hind wing narrow, discal mark and two outer lines faintly darker. Expanse, 40 mm.

Type.—One male, Rio Huacamaya, Carabaya, Peru (Schaus collection), Cat. No. 14986, U.S.N.M.

(24) HYLESIA MYSTICA, new species.

Male.—Fore wing rounded at apex; darkly shaded over lilacine gray; mesial and outer lines faint, pale; discal mark a diffuse narrow dark shade; marginal space pale, defining the scalloped submarginal dark shade. Hind wing with the dark bands dissolved in the ground color, leaving a single curved, pale lilacine band at outer third. Expanse, 32 mm.

Female.—Similar, still more darkly shaded; abdomen with dense lateral and terminal tufts of dark ocher hairs. Expanse, 45 mm.

Cotypes.—Two males, one female, Trinidad, British West Indies (Schaus collection), Cat. No. 14981, U.S.N.M.; also nine males, one female from the Guianas (W. Schaus), apparently identical. In a few of the Guiana males the dark bands of hind wing are incompletely dissolved in the ground and are visible, somewhat contradicting the character assigned in the table.

H. composita Dognin,[1] from Venezuela is apparently closely allied, possibly identical, but it is impossible to be sure of its position without seeing specimens.

(25) HYLESIA ATHLIA, new species.

Male.—Abdomen with dense, slightly ocherous, brown hairs. Fore wing broad, rounded, not square at apex; mouse-gray with slight brown tint; discal mark broadly clouded; lines broad, pale, defined, converging on inner margin; submarginal pale line sinuous. Hind wing with faint dark mark at end of cell; single outer pale line, faintly preceded and followed by darker. Expanse, 40 mm.

Type.—One male, Rio Huacamaya, Carabaya, Peru (Schaus collection), Cat. No. 14987, U.S.N.M.

[1] Mém. Soc. Ent. Belg., 1912, vol. 19, p. 152.

Digitized by Google

(26) HYLESIA CEDOMNIBUS, new species.

Male.—Fore wing square at apex, but not falcate; pale mouse-gray; lines pale, obscure; faint pale spot in cell and at apex. Hind wing with the markings very indistinct, the margin appearing paler, with irregular edge. Expanse, 45 mm.

Cotypes.—Two males, Rio Huacamaya, Carabaya, Peru (Schaus collection), Cat. No. 14988, U.S.N.M.

(27) HYLESIA VINDEX, new species.

Male.—Blackish gray; abdomen except at base dark ocher. Wings darkly shaded; two rather broad pale lines converging toward inner margin; submarginal shade pale, faint; discal mark diffused, dark. Hind wing with dark outer lines defining pale mesial and submarginal bands. Expanse, 38 mm.

Female.—More clouded, the abdomen with lateral and terminal ocher tufts. Expanse, 48 mm.

Cotypes.—Three males, one female, Rio Janeiro, Brazil (Schaus collection), Cat. No. 14983, U.S.N.M.

(28) HYLESIA SOLVEX, new species.

Male.—Similar to *vindex*, rather smaller, the outer pale line on fore wing with a slight blackish inner border, joining the discal spot. Expanse, 31 mm.

Female.—More clouded; abdomen with lateral and terminal tufts of ocher hairs. Expanse, 42 mm.

Cotypes.—One male, one female, Rio Grande do Sul, Brazil (Schaus collection), Cat. No. 14984, U.S.N.M.

This is possibly a race of *vindex*.

(29) HYLESIA CRESSIDA, new species.

Close to *alinda* Druce, but the female with black lateral and terminal tufts. The male is rather smaller than *alinda*, the fore wing less strongly falcate, the markings not quite so distinct.

Cotypes.—Five males, two females, Cuernavaca, Mexico, June and July, 1906 (W. Schaus), Cat. No. 14991, U.S.N.M.

Possibly a northern race of *alinda* Druce. I accept as *alinda* specimens from Costa Rica identified by Schaus. I have no material from the type locality (Guatemala).

H. cressida and *euphemia* are very closely allied in the male. I have a long series of males that I can not certainly assign to either. The abdominal tufts of the females are so different in color that specimens of this sex can not be confused. I have the larvæ of *euphemia*, but those of *cressida* have not been received. The two species occur together. I have females of both from Cuernavaca and Jalapa.

Digitized by Google

(30) HYLESIA EUPHEMIA, new species.

Rosy brown; palpi and legs rosy red. Fore wing square at apex, not falcate; marks as in *alinda*, but blurred and indistinct; abdomen of the male with stiff ocher hairs, banded with blackish; female with lateral and terminal tufts of golden ocher hairs. Expanse, male, 39 mm.; female, 48 mm.

Cotypes.—One male, one female, Misantla, Mexico (W. Gugelmann), bred from larvæ under the No. 80, Cat. No. 14990, U.S.N.M.

The following species have not been referred to in the preceding table and descriptions:

HYLESIA OBSOLETA Stoll.

Bombyx obsoleta STOLL, Pap. Exot., vol. 4, 1780, pl. 304, fig. C.

A female, all pinkish, with ill-defined paler lines. The Cramer figures are mostly very poor and inaccurate in detail, lacking the characteristic appearance of the insects. This makes their identification very difficult. The present species may not be a *Hylesia* at all.

HYLESIA EBALUS Cramer.

Bombyx ebalus CRAMER, Pap. Exot., vol. 1, 1775, pl. 50, fig. G.

A small pinkish male, which might be the male of *obsoleta* Stoll.

HYLESIA METABUS Cramer.

Bombyx metabus CRAMER, Pap. Exot., vol. 1, 1775, pl. 74, fig. D.

A female, all brown, no markings, the fore wing square at apex. This is not at all certainly a *Hylesia*.

HYLESIA DOMINA Stoll.

Bombyx domina STOLL, Pap. Exot., vol. 4, 1780, pl. 304, fig. B.

Referred to *Hylesia* by Dognin,[1] but according to Schaus probably an eupterotid.

HYLESIA LILACINA Dognin.

Hylesia lilacina DOGNIN, Mém. Soc. Ent. Belg., vol. 19, 1912, p. 153.

Described from a female and unplaceable from this sex. A pinkish species with large dark discal mark.

HYLESIA FULVIVENTRIS Berg.

Micrattacus fulviventris BERG, Ann. Soc. Argent., vol. 15, 1883, p. 157.

Said by Berg to be near *H. nigricans*, but more grayish, the margin of fore wing very little oblique and with other differences.

HYLESIA BULAEA Maassen and Weymer.

Micrattacus bulaea MAASSEN and WEYMER, Beitr. Schmett., 1886, figs. 124, 125.

A very remarkably colored species, with bright green border to the hind wings, which are marbled with green below. A male is figured. Quite likely this represents a distinct genus.

[1] Ann. Soc. Ent. Belg., vol. 45, 1901, p. 307.

Digitized by Google

HYLESIA VIOLASCENS Maassen and Weymer.

Micrattacus violascens MAASSEN and WEYMER, Beitr. Schmett., 1886, fig. 126.

A male is figured, a darkly colored, violaceous brown species, the outer line straight, distinct, without any submarginal line or shading. Very distinct and probably not a *Hylesia*. *Automeris obscura* Schaus appears closely allied to this.[1]

HYLESIA VAGANS Walker.

Hyperchiria vagans WALKER, Cat. Brit. Mus., vol. 6, 1855, p. 1312.

Placed in *Hylesia* by Kirby, but according to Schaus an *Ormiscodes*.

HYLESIA NETRIX Stoll.

Bombyx netrix STOLL, Pap. Exot., vol. 4, 1780, pl. 307, fig. B.

Placed in *Hylesia* by Kirby, with doubt. Unknown to me, but apparently not a *Hylesia*.

[1] Journ. N. Y. Ent. Soc., vol. 8, 1900, p. 228.

Digitized by Google

[SCIENTIFIC RESULTS OF THE PHILIPPINE CRUISE OF THE FISHERIES STEAMER "ALBATROSS," 1907–1910.—No. 24.]

DESCRIPTIONS OF SEVEN NEW GENERA AND THIRTY-ONE NEW SPECIES OF FISHES OF THE FAMILIES BROTULIDÆ AND CARAPIDÆ FROM THE PHILIPPINE ISLANDS AND THE DUTCH EAST INDIES.

By LEWIS RADCLIFFE,[1]
Scientific Assistant, United States Bureau of Fisheries.

In the present paper are described 6 new genera and 30 new species of the family Brotulidæ and a new genus and species of the family Carapidæ collected by the U. S. Fisheries steamer *Albatross* on the Philippine expedition.

Family BROTULIDÆ.

This collection of brotulids is noteworthy for the large number of species and individuals taken in tropical waters, comprising 475 specimens, representing 26 genera and 40 species. The region about Gillolo and the Gulf of Tomini, Celebes, are particularly rich in new forms.

The collection is so large that, in the following descriptions of species, when the number of specimens is more than two or three the list of localities has been omitted.

In all cases where the opercular spine is distinct, the length of the head has been measured to its tip instead of to the tip of the opercular flap, and comparative measurements are made in terms of that length.

The urinary bladder is very well developed in many genera, and in a large number of specimens a partial or entire eversion has taken place.

[1] In the study of this collection the writer has been associated with Dr. Hugh M. Smith, who becomes joint author of the new genera and species herein described.

Digitized by Google

Heretofore practically no attempt at a natural classification of the brotulid genera has been attempted, and many of the generic and specific descriptions are lacking in details. These and other factors make the identification of species and their arrangement unusually difficult. This is especially true of the viviparous forms which possess many characters in common and yet have differences which are bewildering if one attempts any reduction in the number of described genera.

In the following key an attempt has been made to arrange the genera according to relationship, as far as could be ascertained:

KEY TO THE GENERA OF BROTULIDS TAKEN ON THE "ALBATROSS" PHILIPPINE EXPEDITION.

a^1. SIREMBINÆ. Clavicular bones greatly produced, meeting below eye; ventral fins inserted under eyes, behind tip of humeral symphysis.

b^1. Preopercle unarmed; snout without sharp spine at tip; head entirely scaled; ventrals simple.....*Sirembo.*

b^2. Preopercle with three spines; snout with a sharp spine as in species of *Lepophidium;* head partially naked; ventrals bifid.....*Hoplobrotula.*

a^2. Position of humeral symphysis normal, behind eyes; ventral fins inserted behind tip of humeral symphysis.

c^1. BROTULINÆ. Snout and lower jaw with barbels; ventral filaments bifid .....*Brotula.*

c^2. Head without barbels.

d^1. NEOBYTHITINÆ. Head (normally) entirely scaled. Species as far as known oviparous.

e^1. Lateral line when present narrow, less than one-third diameter of eye in width, not unusually modified, without an inner series of enlarged plate-like scales covered by band of small scales; no fang-like canines present; ventrals present.

f^1. Lateral line distinct anteriorly, disappearing mesially or posteriorly; preopercle armed.

g^1. Ventral filaments bifid.

h^1. Pectorals simple; preopercle with one or two spines; pyloric cœca large, finger-like, forming a ring around the pylorus and extending onto neighboring part of gut. (Coloration bright)..*Neobythites.*

h^2. Lower pectoral rays detached; angle of preopercle with three small spines; pyloric cœca small or rudimentary.....*Dicrolene.*

g^2. Ventral filaments entire.

i^1. Lateral line terminating posteriorly; pyloric cœca 10 to 12, arranged as in *Neobythites.*

j^1. Teeth in narrow bands; ventrals longer than head; pectorals narrow, of about 21 rays; preopercle truncate, without a distinct incision at angle.....*Homostolus.*

j^2. Teeth in broad bands; ventrals reduced; pectorals with 25 to 28 rays; preopercle rounded, *Neobythites*-like, with a distinct incision on upper angle.....*Monomitopus.*

i^2. Lateral line terminating mesially; pyloric cœca more rudimentary, about five.....*Monomeropus.*

f^2. Lateral line indistinct, rudimentary or absent.

k^1. Head with prominent, outstanding crests, which are almost membranaceous in character; preopercle unarmed, rounded; pseudobranchiæ rudimentary.

Digitized by Google

*l*¹. Pyloric cœca absent; bones of head soft and cavernous without large, distinct mucous cavities or pores with a heavy covering of skin which covers and obscures the angles of the skull; pectorals without free rays, less than one-half total length.

*m*¹. Ventral filaments bifid.

*n*¹. Snout much produced and dilated; body very short, deep and compressed.....*Barathrodemus*.

*n*². Snout not greatly produced and dilated; body elongate.

*o*¹. Teeth in villiform bands; eye distinct, not deep-set; body not anguilliform.....*Bassogigas*.

*o*². Teeth in a single row; eye deep-set; body anguilliform.....*Enchelybrotula*.

*m*². Ventral filaments simple.

*p*¹. Head relatively low, bones of skull obscure; lower half of pectoral produced, rigid, oar-like.....*Eretmichthys*.

*p*². Head strongly arched posteriorly, bones of skull quite distinct, the scales covering it deciduous; pectorals unmodified.

.....*Bassozetus*.

*l*². Rudimentary pyloric cœca present; head massive with distinct mucous cavities or pores; angles of skull not obscured by thick, heavy skin.

*q*¹. Ventral filaments simple; two lower pectoral rays differentiated; pseudo branchiæ small, rudimentary.....*Mixonus*.

*q*². Ventral filaments bifid; pectorals produced into a long, whip-like organ, without detached rays; pseudobranchiæ absent,

.....*Mastigopterus*.

*k*². Head with prominent outstanding crests, covered with deciduous scales; pseudobranchiæ well developed; ventral filaments simple or bifid.....*Glyptophidium*.

*e*². Lateral line very broad, with an inner series of enlarged plate-like scales covered by a band of smaller scales.

*r*¹. Ventrals absent; head with outstanding crests; no fang-like canines; parapophyses normal.....*Lamprogrammus*.

*r*². Ventral filaments simple; bones of head firm; fang-like teeth present; parapophyses greatly enlarged.....*Hypopleuron*.

*d*². BYTHITINÆ. Head naked or only partially scaled; ventrals present or absent; small cilia often present on naked portion of head. Species as far as known viviparous.

*s*¹. Caudal differentiated, with a distinct stem; cheeks scaly.....*Dinematichthys*.

*s*². Caudal not differentiated.

*t*¹. Ventral filaments present; preopercle without well-developed spines; three developed gill-rakers on first arch.

*u*¹. Head naked; lateral line incomplete or absent; body elongate.

Diplacanthopoma (*Sarcocara*).

Digitized by Google

u^2. Cheeks, opercles, and usually top of head posteriorly scaled; lateral line interrupted in the middle; body relatively short.

v^1. Palatine teeth absent; margin of preopercle firm, ending in an obtuse-angled point. *Grammonus.*

v^2. Palatine teeth present; margin of preopercle fleshy, unarmed.

w^1. Head low, depressed; tips of clavicular bones firmly united; D. 85 to 98; A. 68.

x^1. Ventral filaments simple; eyes superior; rudimentary pyloric cœca present... *Catætyx.*

x^2. Ventral filaments bifid; eyes dorso-lateral; head pike-like; pyloric cœca absent. *Luciobrotula.*

w^2. Head robust, rounded; tips of clavicular bones more or less free; D. 76; A. 52... *Bythites.*

t^2. Ventrals absent; six or more developed gill-rakers on first arch.

y^1. Head normal, cheeks and opercles scaled; preopercle armed with five spines; six developed gill-rakers on first arch; rudimentary pyloric cœca present; lateral line present... *Xenobythites.*

y^2. (HEPHTHOCARINÆ.) Head greatly dilated, covered with a thick, gelatinous, scaleless skin; pyloric cœca absent; lateral line indistinguishable..... *Hephthocara.*

Genus NEOBYTHITES Goode and Bean.

Neobythites GOODE and BEAN, Proc. U. S. Nat. Mus., vol. 8, 1885, p. 600, *gilli.*
Watasea JORDAN and SNYDER, Proc. U. S. Nat. Mus., vol. 23, 1901, p. 765, *sivicola.*

Body elongate, compressed; head rounded, its bones firm, both head and body covered with small cycloid scales; tail not filamentous, lateral line usually distinct, becoming obsolete posteriorly; operculum armed with a single strong spine; preoperculum armed at or near its angle with 1 or 2 small spines; no barbels; mouth large, snout moderate, rounded, projecting very slightly beyond mouth; teeth villiform, in broad bands on both jaws, palatines, tongue, and lower pharyngeals, a patch on vomer, and 5 small patches on each side on upper pharyngeals; gill-openings wide, the membranes deeply cleft and not attached to the isthmus; vertical fins united; ventrals

Digitized by Google

filamentous, each of 2 rays separate at tip, their bases not close together, inserted behind tip of humeral symphysis; pseudobranchiæ present; pyloric cœca finger-like in a ring around the pylorus, and in 2 short rows along neighboring part of gut.

There are slight variations in the form and armature of the preopercle. In several species including the type there is a single spine-like tip at or near the angle of the preopercle; in others there is an additional small spine above the first, which character is used as the basis of the genus *Watasea*. We find a corresponding amount of variation in some of the other closely related genera and do not consider this character of generic value.

NEOBYTHITES LONGIPES Smith and Radcliffe, new species.

Plate 7, fig. 1.

Dorsal 95; caudal 11; anal 80; ventrals 2; pectorals 26.

Head 4.25 (4.58 in total length), long, low, subconic; body moderately compressed, greatest depth 5.05 (5.44 in total length); eye 5.08, elliptical oval; snout 4, long, pointed, not projecting beyond mouth; mouth large, oblique, lips thin, upper jaw overhanging lower; maxillary 1.89, reaching beyond vertical from posterior margin of eye for slightly less than a half diameter of eye, posterior end of maxillary incised, as broad as eye; teeth small, blunt, in bands on jaws, on vomer, palatines and tongue, a narrow band along the hypobranchial between bases of third and fourth gill-arch, diverging bands on lower pharyngeals; opposed to these, on each side of the roof of the pharynx, are five small patches of teeth; patch on vomer ∩-shaped, palatine bands mesially somewhat broader than mandibular bands; interorbital 4.85, broad, slightly convex; nostrils widely separated, the anterior circular, with a raised border, near edge of snout, posterior near eye; opercle armed with a single sharp spine, a short flat spinule at angle of preopercle; above this the margin is incised as in species of *Watasea*, but the spinule which marks the upper termination of this incision in species of *Watasea* is lacking in this species; pseudobranchiæ well developed; gill-rakers 4+7, the longest slightly less than a half-diameter of eye; a ring of long finger-like pyloric cœca around the pylorus, and a short series along each side of the neighboring part of gut, the longest of these about equal to major diameter of eye; scales small, cycloid, elliptical-oval, completely covering head and body, surface of each scale covered with a network of radiating and concentric striæ after the pattern of a spider's web; 10 scales in a series from origin of dorsal to and including lateral line; vertical fins scaled nearly to margin; lateral line in upper third of body, disappearing at a point about 0.4 length of head from base of caudal.

Dorsal and anal continuous with the caudal, tips of last rays extending to posterior fourth of caudal; distance of dorsal from tip of

Digitized by Google

snout 3.73 (4.03 in total length), distance of anal from tip of snout 2.07 (2.24 in total length); distance of anal from lower pectoral base equal to length of head; ventrals bifid, bases well separated, inserted slightly behind humeral symphysis, inner ray longest, more than twice as long as head, 1.87 (2.01 in total length), outer ray 0.5 as long as inner ray, 1.07 in the distance from base to origin of anal; pectorals 1.70 in head, acutely rounded.

Color in alcohol: Raw sienna, becoming pearl-gray on belly; sides and ventral surface of head and body finely punctulate with darker; traces of a brownish band extending from tip of snout through middle of eye to tip of opercular spine; ground color of dorsal dusky gray, a large black ocellus margined with lighter lies between the twenty-first and thirty-second rays; behind this is a median band of dusky black, widening posteriorly until it covers nearly the entire fin; upper rays of caudal dusky gray, distal two-thirds of lower rays black; anterior half of anal gray, punctulate with darker, color changing to black on posterior rays, the black coloration not extending to base of rays; paired fins gray, finely punctulate with darker; peritoneum very dark brown.

Type.—Cat. No. 74126, U.S.N.M., 30.2 cm. in length, taken with a beam trawl at station 5550 (lat. 6° 02′ 00″ N.; long 120° 44′ 40″ E.), near Jolo, at a depth of 258 fathoms, on a bottom of fine sand and shells.

This species is readily distinguished from the other members of the genus by the elongate ventrals and the characteristic form of the preopercle.

In an example 9.8 cm. long, from station 5580, Darvel Bay, Borneo, a dark-brown band extends from tip of snout through eye, alongside of head and body, interrupted below dorsal ocellus, continuing again along side in a slight arch to within a head length of base of caudal; indistinct brown markings on top of head, and a broad arch of brown from upper angle of opercle to below dorsal ocellus; a brown blotch on side behind ocellus. Some examples of intermediate size show faint indications of these markings.

NEOBYTHITES (WATASEA) UNIMACULATUS Smith and Radcliffe, new species.

Plate 7, fig. 2.

Dorsal 83; caudal 10; anal 71; ventrals 2; pectorals 26.

Head 4.37 (4.75 in total length), short, subconic; body elongate, compressed, greatest depth 5.10 (5.52 in total length); eye 4.67, subelliptical; snout as long as eye, subconic, blunt, projecting but slightly beyond mouth; mouth large, slightly oblique, lips thin, upper jaw overhanging lower; maxillary 1.90, reaching beyond vertical from posterior margin of eye for about 0.5 an eye diameter, longer than snout plus eye, upper edge slipping under suborbital; teeth

Digitized by Google

small, blunt, arranged as in *macrops*, interorbital 4.37, convex; nostrils widely separated as in related species; opercle armed with a single long, sharp spine; a sharp spinule at angle of preoperculum, a second slightly shorter spinule about 0.5 an eye diameter above this; pseudobranchiæ present, consisting of several quite well-developed filaments; gill-rakers 5+12, reduced to mere protuberances at ends; pyloric cœca long, finger-like, arranged as in other species of the genus; scales small, cycloid, entirely covering head and body, 9 or 10 in a series from origin of dorsal to and including lateral line; lateral line in upper third of body, disappearing at a point slightly less than 0.5 length of head from base of caudal.

Dorsal and anal continuous with the caudal, the last rays extending to about the middle of caudal fin; distance of dorsal from tip of snout 4 (4.30 in total length); distance of anal from tip of snout 2.34 (2.53 in total length); distance of anal from lower pectoral base four-sevenths length of head; ventrals bifid, bases well separated, inserted slightly behind humeral symphysis, inner ray longest, 1.21 in head, 1.24 in the distance from its base to origin of anal; pectorals 1.60 in head, acutely rounded.

Color in alcohol: Clay, lighter ventrally, becoming dusky pearl-gray on belly; brownish shades along back above lateral line, a line of similar color along side, the lighter interspace crossed by lines of a darker coloration, posteriorly these extend downward to base of anal; dorsal dusky gray,, median portion posteriorly much darker; a large, black, white-rimmed ocellus on dorsal, the black portion lying between fourteenth and twenty-fourth rays; caudal dusky; anterior anal rays light gray, minutely dotted with darker; beginning with the fourteenth ray there is a narrow, mesial, dusky line which becomes broader posteriorly, until it covers nearly the entire width of fin; paired fins gray, finely punctulate with darker; peritoneum brownish black.

Type.—Cat. No. 74127, U.S.N.M., 16.6 cm. in length, taken with a beam trawl at station 5590 (lat. 4° 10′ 50″ N.; long. 118° 39′ 35″ E.), near Mabul Island, Borneo, at a depth of 310 fathoms, on a bottom of green mud and sand.

This species closely resembles our examples of *N. macrops*, but differs in having fewer rays in the dorsal and anal (dorsal about 96, anal about 83 in *macrops*), and in the presence of but a single ocellus upon the dorsal fin. The collection contains a single other example from station 5520, off northern Mindanao.

NEOBYTHITES (WATASEA) PURUS Smith and Radcliffe, new species.

Plate 7, fig. 3.

Dorsal about 87; caudal 12; anal 70; ventrals 2; pectorals 27.

Head 4.35 (4.74 in total length), subconic; body elongate, compressed, greatest depth 5.25 (5.75 in total length); eye 4.86, sub-

Digitized by Google

circular; snout 4.15, pointed, projecting beyond mouth; mouth large, slightly oblique, lips thin, upper jaw overhanging lower; maxillary 1.89, reaching beyond vertical from posterior margin of eye for about 0.5 an eye diameter, its length greater than snout plus eye; teeth small, blunt, arranged as in *unimaculatus;* interorbital 4.25, convex; opercle armed with a single sharp spine, a small spinule at angle of preoperculum, a second about 0.5 an eye diameter above this, these project but little beyond the skin covering preopercle; pseudobranchiæ consisting of several small filaments; gill-rakers 5+11; pyloric cœca finger-like, arranged as in other species of the genus; 10 scales in a series from origin of the dorsal to and including lateral line; lateral line disappearing at a point less than 0.5 the length of the head from base of caudal.

Dorsal and anal continuous with the caudal, the last rays extending nearly to middle of caudal fin; distance of dorsal from tip of snout 3.60 (4.03 in total length); distance of anal from tip of snout 2.51 (2.73 in total length); distance of anal from pectoral base about 0.7 length of head; ventrals bifid, bases well separated, inserted slightly behind humeral symphysis, inner ray longest, 1.37 in head, 1.33 in the distance from base to origin of anal; pectorals 1.55 in head, acutely rounded.

Color in alcohol: Back above lateral line wood-brown, becoming lighter below; belly pearl gray, punctulate with darker; vertical fins dusky gray; caudal and basal portion of anal posteriorly darker, paired fins pearl-gray, finely punctulate with darker; peritoneum brownish black.

Type.—Cat. No. 74128, U.S.N.M., 16.1 cm. in length, taken with a beam trawl at station 5392 (lat. 12° 12′ 35″ N.; long. 124° 02′ 48″ E.), near Destacado Island between Samar and Masbate, at a depth of 135 fathoms, on a bottom of green mud and sand.

This species is very close to *N. unimaculatus*, from which it is distinguished by the entire absence of a black ocellus on the dorsal fin, the slightly greater number of rays in the dorsal fin, by the more anterior insertion of dorsal and anal, and by the smaller size of the ventrals. The collection contains a single other example from the neighboring station 5393.

NEOBYTHITES (WATASEA) FASCIATUS Smith and Radcliffe, new species.

Plate 7, fig. 4.

? *Watasea sivicola* JORDAN and STARKS, Bull. U. S. Fish Comm., vol. 22, 1902, p. 601, pl. 3, fig. 3, 1904, Suruga Bay, Sagami Bay, Japan.

Dorsal 96; caudal 9; anal 81; ventrals 2; pectorals 25.

Head 4.74 (5.08 in total length), short, subquadrangular in transverse section; body elongate, compressed, greatest depth 4.87 (5.22 in total length); eye 4.13, large, subcircular; snout as long as eye, blunt,

Digitized by Google

fleshy, less pointed than in *macrops;* mouth comparatively small, nearly horizontal, lips fleshy, upper jaw overhanging lower; maxillary 2.05, reaching slightly beyond vertical from posterior margin of eye, shorter than in related species, equal to snout plus eye, entire upper edge slipping under the suborbital; bands of small blunt teeth on jaws, vomer, palatines, tongue, hypobranchiæ and lower pharyngeals, 5 small patches on each side of roof of pharynx, those on the vomer arranged in a triangular patch, differing in this respect from related species; interorbital convex, its width nearly equal to diameter of eye; nostrils rather widely separated, the anterior subtubular, near edge of snout, the posterior close to eye; opercle armed with a single sharp spine; a short, flat spinule at angle of preoperculum, and another similar but slightly shorter spinule a short distance above it; pseudobranchiæ present, consisting of 3 or 4 small filaments; gill-rakers 5+15, rather long near the middle of arch, reduced to mere protuberances at the ends, longest about 0.5 diameter of eye; a ring of extremely short cœca around the pylorus, and a short series of somewhat larger cœca along each side of the neighboring part of the gut; scales small, cycloid, elliptical-oval, 9 or 10 in a series from origin of dorsal to and including lateral line, 31 from origin of anal to lateral line, vertical fins scaled at base; lateral line slightly arched anteriorly, disappearing at a point about 0.5 the length of head from the base of the caudal.

Dorsal and anal continuous with the caudal, last rays extending about to middle of caudal fin; distance of dorsal from tip of snout 4 (4.29 in total length); distance of anal from tip of snout 2.40 (2.58 in total length); distance of anal from lower pectoral base slightly less than length of head; ventrals short, bifid, bases well separated, inserted slightly behind humeral symphysis, inner ray longest, 1.52 in head, 1.86 in the distance from its base to origin of anal; pectorals 1.52 in head, acutely rounded.

Color in alcohol: Dusky clay, becoming dusky gray on belly, a narrow dark russet band from tip of snout through middle of eye extending backward along side for nearly a head-length beyond tip of opercular spine, a similar band extending from above eye along back at base of dorsal, terminating above end of first band, the two ends connected by a slightly broader vertical band of the same color, behind this there are 6 crossbands of similar coloration, first, third, and fifth continued on dorsal and anal, where the color becomes dark brown or black; second, fourth, and sixth bands narrower, indistinct below middle of side, adjacent portion of vertical fins dusky; interspaces on vertical fins dusky white, becoming blackish behind fifth crossband, each fin narrowly margined with white; paired fins dusky gray; peritoneum dark brown. (Coloration of smaller examples much more distinct than in the type.)

Digitized by Google

Type.—Cat. No. 74129, U.S.N.M., 19.3 cm. in length, taken with a beam trawl at station 5290 (lat. 13° 40′ 09″ N.; long. 120° 59′ 30″ E.), in Batangas Bay, Luzon, at a depth of 214 fathoms, on a bottom of lava and gravel.

From *N. macrops* Günther this species differs in having the head shorter, tip of snout more prominent and fleshy, maxillary shorter (equal to snout plus eye), ventrals shorter, vomerine teeth in a triangular patch (Y-shaped in *macrops*), and body crossed by well-defined bands of darker coloration. From the alleged cotype of *N. sivicola* (Jordan and Snyder), from Yokohama, in the United States National Museum, which we have examined, it differs in having 9 or 10 scales from origin of dorsal to and including lateral line (12 or 13 in *sivicola*), the mouth smaller, maxillary much shorter, distance from snout to vent much less, distance from lower pectoral base to origin of anal less than length of head (considerably greater in *sivicola*), and vomerine teeth in a triangular instead of a Y-shaped patch. The Yokohama specimen of *N. sivicola* is much faded, and there are no traces of darker cross-bands on body or fins.

Examples from Suruga and Sagami Bays, Japan, identified by Jordan and Starks as *Watasea sivicola*, agree very closely with our examples of *N. fasciatus*, but their drawing fails to show the banded appearance of our examples. Their statement "greater distance from snout to vent" should read "lesser distance."

Genus DICROLENE Goode and Bean.

Dicrolene Goode and Bean, Bull. Mus. Comp. Zoöl., vol. 10, 1883, p. 202, *intronigra*.

This genus differs from *Neobythites* in the relatively weaker, more porous character of the bones of the head; more deciduous scales; margin of preopercle armed with three small sharp spines; ventrals reduced; pyloric cœca small or rudimentary, in reduced number; lower pectoral rays detached, not connected by membrane; pseudobranchiæ very small (said to be absent in some species).

DICROLENE LONGIMANA Smith and Radcliffe, new species.

Plate 8, fig. 1.

Dorsal 103; caudal 7; anal 83; ventrals 2; pectorals 16+8.

Head 4.70 (5.21 in total length), long, low, nearly as broad as high; body slender, tapering, greatest depth 5.75 (6.37 in total length); eye 4.80, small, subelliptical; snout 4.08, short, rather blunt, not overhanging mouth; mouth large, slightly oblique, upper jaw overhanging lower; maxillary 1.75, extending beyond vertical from posterior margin of eye for 0.6 an eye diameter; teeth small, villiform; patch on vomer narrow, semicircular; interorbital 4.26, narrow, slightly convex; opercle armed with a single strong sharp spine;

Digitized by Google

angle of preopercle armed with three spines; pseudobranchiæ consisting of 2 small, rudimentary filaments; gill-rakers 5+20, the longest slightly more than 0.7 as long as eye; 5 short rudimentary cœca around pylorus; scales small, cycloid, deciduous, covering head and body and forming a scaly sheath at base of dorsal and anal; 7 scales in a series from origin of dorsal to and including lateral line, about 19 from origin of anal to lateral line; the sculpturing of scales essentially as in *Neobythites*, except that the circuli are less distinct; lateral line broad, disappearing on posterior half of tail.

Dorsal and anal continuous with caudal; distance of dorsal from tip of snout 3.71 (4.12 in total length), distance of anal from tip of snout 2.37 (2.63 in total length); lower pectoral base and anal separated by a distance equal to length of head; ventrals small, rather widely separated at base, each consisting of 2 rays united for a short distance, inner ray longest, 1.63 in head; upper pectoral rays united, the longest a little longer than head; lower rays separate, long, filamentous, the longest about 2.6 times as long as head, 0.5 total length.

Color in alcohol: Raw umber; opercular region, branchiostegals and fins dark clove brown; peritoneum dark chestnut brown.

Type.—Cat. No. 74130, U.S.N.M., 25.5 cm. in length, taken with a beam trawl at station 5488 (lat. 10° 00′ 00″ N.; long. 125° 06′ 45″ E.), between Leyte and Mindanao, at a depth of 772 fathoms, on a bottom of green mud.

Our examples of this species were taken from the interinsular waters of the Philippine Archipelago. One specimen 18.5 cm. in length from station 5406 was from the stomach of a *Lophiodes infrabrunneus* Smith and Radcliffe 12.7 cm. in length.

According to Alcock's description of examples of *D. intronigra* from the Andaman and Arabian seas, that species has 18 or 19+8 or 9 rays in the pectoral, the longest 1.5 to 2 times the length of the head, the inner ventral ray equal to length of head behind middle of eye, and the distance from base of pectoral to first anal ray more than the length of the head.

DICROLENE TRISTIS Smith and Radcliffe, new species.

Plate 8, fig. 2.

Dorsal 103; caudal 6; anal 80; ventrals 2; pectorals 18+10.

Head 4.85 (5.31 in total length), low subconic, more porous than in *longimana;* body compressed, greatest depth 5.83 (6.38 in total length); eye 4, large, subcircular; snout 3.82, rounded; mouth large, oblique, upper jaw overhanging lower, maxillary 1.71, extending beyond vertical from posterior margin of eye for 0.33 an eye diameter, posterior margin truncate, teeth small, villiform, the patch on vomer

Digitized by Google

broadly ∩-shaped; interorbital 3.43, broad, flattened; opercle armed with a single strong sharp spine; angle of preopercle armed with 3 small sharp spines; pseudobranchiæ consisting of 2 small filaments; gill-rakers 5+20, the longest nearly 0.75 as long as eye; slight traces of rudimentary pyloric cœca; scales small, cycloid, deciduous, covering head and body, and forming a low sheath at the base of dorsal and anal; 8 scales in a series from origin of dorsal to and including lateral line, about 25 from origin of anal to lateral line; lateral line broad, distinct anteriorly, disappearing at about a head's length from base of caudal.

Dorsal and anal continuous with caudal; distance of dorsal from tip of snout 4 (4.10 in total length); distance of anal from tip of snout 2.43 (2.66 in total length); ventrals small, rather widely separated at base, each consisting of 2 rays united by membrane for a very short distance at base, inner ray longest, 2.23 in head, ventral base behind tip of humeral symphysis; upper pectoral rays united, the longest about equal to head, lower rays separate, filamentous, 1.5 times as long as head, base of lower rays about a head-length in advance of anal.

Color in alcohol: Tawny olive; opercular region, branchiostegals, and fins dark clove brown; peritoneum dark chestnut brown.

Type.—Cat. No. 74131, U.S.N.M., 25.5 cm. in length, taken with a beam trawl at station 5467 (lat. 13° 35′ 27″ N.; long. 123° 37′ 18″ E.), Lagonoy Gulf, Luzon, at depth of 480 fathoms, on a bottom of gray mud.

The examples in the collection came from the east coast of Luzon; Sibuko Bay, Borneo; and from the Celebes; none were taken in the interinsular waters of the Philippine Archipelago.

The number of detached pectoral rays varies from 8 to 10.

This species differs from *longimana* in the much larger eye, longer snout, broader interorbital, shorter ventrals and pectorals, rudimentary character of pyloric cœca, smaller scales and lighter coloration. It appears to be closely related to *D. multifilis* (Alcock) but identification from the description and figure of that species is impossible.

HOMOSTOLUS Smith and Radcliffe, new genus.

This genus is closely related to *Neobythites*, distinguished by the elongate, sharply pointed, compressed head which is very cavernous but lacks the high crests characteristic of *Glyptophidium;* by the narrow bands of teeth, especially those on mandible, and by the long, simple ventral filaments, each composed of 2 fused rays. The eyes are very large; the lateral line is broad, with a clearly defined covering of skin above the scales, the latter wider than those above and below and distinctly modified.

Type of the genus.—Homostolus acer, new species.

Digitized by Google

HOMOSTOLUS ACER Smith and Radcliffe, new species.

Plate 8, fig. 3.

Dorsal about 93; caudal 10; anal about 70; ventrals 1; pectorals 21.

Head 4.50 (4.75 in total length), long, pointed, low, compressed, cavernous, the bony crests much less prominent than in species of *Glyptophidium*, subquadrangular in transverse section; body compressed, relatively short, greatest depth 5.54 (5.90 in total length); eye 3.41, elliptical-oval; snout 3.41, as long as eye, low, pointed, slightly overhanging maxillary; mouth long, narrow, oblique, upper jaw overlapping lower except at tip, where a knob at tip of mandibular symphysis projects slightly; maxillary 1.64, extending about 0.5 an eye diameter beyond vertical from posterior margin of eye; narrow bands of minute villiform teeth on jaws, vomer, palatines and tongue, 5 small patches of teeth on roof of mouth posteriorly as in *Neobythites;* interorbital 3.72, flattened, slightly broader than eye; nostrils small, the posterior close to eye; opercular spine slender, sharp; 2 small spines at angle of preopercle; pseudobranchiæ small; gill-filaments short; gill-rakers 7+20, long and slender, the longest about 0.7 diameter of eye; about 10 long, finger-like pyloric cœca arranged as in *Neobythites;* scales small, cycloid, *Neobythites*-like, 9 in a series from origin of dorsal to lateral line, about 18 from origin of anal to lateral line; lateral line broad and distinct, disappearing within 0.5 a head length from base of caudal.

Dorsal and anal continuous with the caudal; origin of dorsal from tip of snout 3.76 (4.15 in total length), its rays somewhat longer than those of anal; caudal narrow, pointed; origin of anal from tip of snout 2.52 (2.67 in total length); ventrals elongate, 1.55 times length of head, each composed of 2 closely bound rays, the inner the longest, bases rather widely separated, situated behind tip of humeral symphysis; pectoral 1.64, narrow.

Color in alcohol: Dusky ocher yellow, darkest dorsally, becoming dusky cream-buff on belly and sides and ventral surface of head; opercular region silvery; fins dusky, dorsal and anal margined with blackish, darkest anteriorly; peritoneum blackish brown.

Type.—Cat. No. 74132, U.S.N.M., 19.5 cm. in length, taken with a beam trawl at station 5508 (lat. 8° 17′ 24″ N.; long. 124° 11′ 42″ E.), in Iligan Bay, Mindanao, at a depth of 270 fathoms, on a bottom of green mud and fine sand.

This species is found in the same general regions as our examples of *Glyptophidium.*

Digitized by Google

Genus MONOMITOPUS Alcock.

Monomitopus Alcock, Ann. Mag. Nat. Hist., p. 297, Oct., 1890, *nigripinne*.
Dicromita Goode and Bean, Oceanic Ichthyology, p. 319, 1895, *agassizii*.

This genus differs from *Neobythites* in the weaker, more spongy character of the bones of the head; scales more deciduous; lower margin of preopercle more produced, armed with 2 or 3 weak spine-like projections and with a distinct incision in region of angle; ventrals reduced, inserted close together, each of 2 closely united rays, not separate at tips. The ring of pyloric cœca around the pylorus may or may not extend on neighboring part of gut. The type of *Dicromita* (*agassizii*) does not differ generically from *Monomitopus*.

MONOMITOPUS PALLIDUS Smith and Radcliffe, new species.

Plate 9, fig. 1.

Dorsal 93; caudal 7; anal 76; ventrals 1; pectorals 28.

Head 4.73 (5.22 in total length), short cavernous, subquadrangular in transverse section, slightly arched posteriorly; body short, compressed, greatest depth 5.56 (6.12 in total length); eye 3.90, large, elliptical-oval; snout 3.90, short, broad, slightly overhanging mouth; mouth of moderate size, oblique, upper jaw overhanging lower; maxillary 1.94, reaching a little beyond vertical from posterior margin of eye, posterior end expanded, truncate, its width more than 0.5 an eye-diameter; teeth small, villiform, the outer row in jaws somewhat enlarged, differing in this respect from the other Philippine species; patch on vomer ⅄-shaped; interorbital 3.36, broad, convex; nostrils widely separated, anterior without well-developed tube; opercle armed with a single sharp spine; angle of preopercle formed as in the subgenus *Watasea*, with 2 sharp spines, the lower being nearly as strong as in the species of that subgenus; pseudobranchiæ distinct, slender; gill-rakers 7 + 16, long, slender, the longest about 0.66 diameter of eye; a ring of 11 small finger-like cœca extending around the pylorus, one on each side being on the neighboring part of the gut; scales small, cycloid, deciduous, covering head and body, and forming a sheath along base of dorsal and anal, about 8 in a series from origin of dorsal to and including lateral line; the surface of the scale is intermediate between that found in species of *Neobythites* and other Philippine species of *Monomitopus*, the radiating striæ persisting over entire surface of scale, these are much more rudimentary in character than in species of *Neobythites;* lateral line broad, distinct anteriorly, disappearing at a point about equal to length of head from base of caudal.

Dorsal and anal continuous with caudal, the last rays extending nearly to middle of caudal fin; distance of dorsal from tip of snout 4.12 (4.54 in total length); distance of anal from tip of snout 2.25 (2.47 in total length); distance of anal from lower pectoral base about equal

Digitized by Google

to head; ventrals slender, close together, each consisting of 2 closely-bound rays, the inner 1.61 in head, reaching more than half way to origin of anal; ventral base slightly behind tip of humeral symphysis; pectorals 1.68.

Color in alcohol: Fawn on back, becoming light smoke-gray on head and belly; anterior rays of dorsal and anal smoke gray; posterior rays and caudal light clove brown; ventrals gray; pectorals gray; punctulate with darker; inside of mouth plumbeous, changing to seal-brown in region surrounding gills; peritoneum dark seal-brown.

Type.—Cat. No. 74133, U.S.N.M., 19.5 cm. in length, taken with a beam trawl at station 5259 (lat. 11° 57′ 30″ N.; long. 121° 42′ 15″ E.), between Mindoro and Panay, at a depth of 312 fathoms, on a bottom of gray mud and globigerina ooze.

The close relationship of *Monomitopus* to *Neobythites* is well shown in the characters of this species; the bones of the head are more cavernous, the scale are deciduous but *Neobythites*-like in character, and the two rays composing each ventral are fused.

This species differs from our examples of *M. nigripinnis* in having the outer row of teeth in the jaws enlarged, the armature of the preopercle stronger, radiating striæ on scales extending over entire surface, fewer rays in dorsal, anal, and pectoral, larger eye, longer ventral, and lighter coloration.

MONOMITOPUS LONGICEPS Smith and Radcliffe, new species.

Plate 9, fig. 2.

Dorsal 97; caudal 9; anal 81; ventrals 1; pectorals 28.

Head 3.94 (4.21 in total length), long, robust, arched posteriorly, cavernous; body short, deep, compressed, greatest depth 4.60 (4.92 in total length); eye 5.43, subelliptical; snout 4, broad, blunt; mouth large, slightly oblique; upper jaw overhanging lower; maxillary 1.84, reaching beyond vertical from posterior margin of eye for about 0.7 of an eye diameter, posterior end expanded very slightly incised, its width about equal to diameter of eye; teeth small, blunt, in villiform bands, the patch on vomer Λ-shaped; interorbital 3.53, very broad, probably convex in life; nostrils widely separated; opercle armed with a single sharp spine, margin of preopercle weak, irregularly crenulate, armed with three weak, spine-like projections; pseudobranchiæ small; gill-rakers 5+22, long, slender, the longest slightly less than 0.7 diameter of eye, the outer ones reduced to small knob-like protuberances; a ring of 10 large finger-like pyloric cœca extending around the pylorus out onto the neighboring part of gut; scales small, cycloid, deciduous, completely covering head and body, 8 or 9 scales in a series from origin of dorsal to and including lateral line, 27 from origin of anal to lateral line; dorsal and anal with a scaly sheath-like base; lateral line broad, distinct, disappearing at a point more than half head-length from base of caudal.

Digitized by Google

Dorsal and anal continuous with the caudal; distance of dorsal from tip of snout 3.48 (3.72 in total length); distance of anal from tip of snout 2.17 (2.32 in total length); distance of anal from lower pectoral base about 0.7 length of head; ventrals small, close together, each consisting of 2 loosely-bound rays, the tips of which may become torn apart, bases slightly behind tip of humeral symphysis, a head-length in front of origin of anal; pectorals broken.

Color in alcohol: Raw sienna; fins, lateral line, branchiostegal membranes, margin of eye, and lips dusky brownish-black; inside of mouth washed with plumbeous; peritoneum very dark seal brown.

Type.—Cat. No. 74134, U.S.N.M., a single example 32 cm. in length, taken with a beam trawl at station 5299 (lat. 20° 5′ 00″ N.; long. 116° 5′ 00″ E.), in the China Sea south of Hongkong, at a depth of 524 fathoms, on a bottom of gray mud and sand.

MONOMITOPUS MICROLEPIS Smith and Radcliffe, new species.

Plate 9, fig. 3.

Dorsal 95; caudal 8; anal 78; ventrals 1; pectorals 28.

Head 4.52 (5 in total length), long, rather pointed in the adult; body elongate, compressed, greatest depth 5.58 (6.25 in total length); eye 5.32, small, elliptical-oval; snout 3.85, long, slightly overhanging mouth; mouth of moderate size, slightly oblique, upper jaw overhanging lower; maxillary 1.92, reaching beyond vertical from posterior margin of eye for a distance nearly equal to five-eighths diameter of eye, its expanded posterior end very slightly incised; teeth small, villiform, the patch on vomer ∧-shaped; interorbital 3.71, broadly convex; opercle armed with a single sharp spine; angle of preopercle with a deep incision, the spine-like tips above and below this flat and thin (smaller examples have the double incision more closely approximating the form found in the type of the genus); pseudobranchiæ very small, of 2 filaments, partially concealed in a depression; gill rakers 5+17, the longest about five-eighths diameter of eye, the 7 outer ones on lower arch reduced to mere protuberances; a ring of 11 pyloric cœca around the pylorus, one on each side being on the neighboring part of the gut, those on the sides being much longer, finger-like; scales smaller than in related species, cycloid, more or less deciduous, covering head and body, and forming a sheath along base of dorsal and anal, 12 or 13 in a series from origin of dorsal to and including lateral line, 35 from origin of anal to lateral line; as in typical examples, radial striæ are found only on the basal end of the scale, but the concentric lines are fewer in number and farther apart; lateral line distinct, disappearing at a point slightly less than length of head from base of caudal.

Dorsal and anal continuous with the caudal, the last rays extending to middle of caudal fin; distance of dorsal from tip of snout 3.84

Digitized by Google

(4.31 in total length); distance of anal from tip of snout 2.42 (2.72 in total length); distance of anal from lower pectoral base 1.16 in head; ventrals slender, close together, each consisting of 2 closely bound rays, the inner 1.67 in head, ventral base slightly behind tip of humeral symphysis, at a distance from anal somewhat greater than length of head; pectoral 1.56.

Color in alcohol: Ground color burnt umber, darkest on back and head; fins and peritoneum dark seal brown.

Type.—Cat. No. 74156, U.S.N.M., 25 cm. in length, taken with a beam trawl at station 5410 (lat. 10° 28′ 45″ N.; long. 124° 05′ 30″ E.), between Cebu and Leyte, at a depth of 385 fathoms, on a bottom of green mud.

This species differs from *M. nigripinnis* in the more elongate form of head and body, smaller eye, smaller scales, and darker coloration.

Genus MONOMEROPUS Garman.

Monomeropus GARMAN, Deep Sea Fishes, 1899, p.158, *malispinosus*. (No generic description.)

Brotulids similar in structure and appearance to *Monomitopus* but distinguished by the more cavernous structure of the head and weaker armature of opercle and preopercle; by the more rudimentary character of the lateral line which ends above or slightly behind origin of anal; by the smaller number and the more rudimentary character of the pyloric cœca; and by the smaller ventral filaments.

MONOMEROPUS GARMANI Smith and Radcliffe, new species.

Plate 10, fig. 1.

Dorsal 96; caudal 8; anal 80; ventrals 1; pectorals 31.

Head 4.91 (5.20 in total length), short, deep, slightly depressed anteriorly, strongly arched posteriorly; body compressed, greatest depth 5.52 (5.85 in total length); eye 5.30, small, subcircular; snout 4.08, short, as broad as long, very slightly overhanging mouth; mouth large, oblique, upper jaw overhanging lower; maxillary 1.77, reaching beyond vertical from posterior margin of eye for about 0.7 an eye diameter, posterior end expanded, its breadth equal to diameter of eye, upper margin slipping under suborbital; teeth small, villiform; head of vomer prominent, knob-like, covered with teeth, a narrow short series on each side extending backward nearly to palatines; interorbital 3.21, broad, convex; nostrils widely separated; opercle armed with a single slender spine; angle of preopercle with a double incision, and traces of three flat, weak points, weaker than in typical examples of *Monomitopus;* pseudobranchiæ consisting of 2 small filaments, gill-rakers 5+22, long, slender, longest 0.65 diameter of eye; a ring of 5 small, rudimentary cœca extending around the pylorus; scales small, cycloid, deciduous, covering head and body,

Digitized by Google

and forming a sheath along base of dorsal and anal; 7 or 8 scales in a series from origin of dorsal to and including lateral line, 25 from origin of anal to lateral line; sculpturing of scale as in typical examples of *Monomitopus;* lateral line inconspicuous, disappearing at a point slightly behind origin of anal.

Dorsal and anal continuous with the caudal; distance of dorsal from tip of snout 4.13 (4.37 in total length); distance of anal from tip of snout 2.57 (2.72 in total length); ventrals short, slender, very close together, broken, presumably less than 0.25 length of head; pectorals 1.83, broad, scaled at base.

Color in alcohol: Clove-brown; opercular region blackish; fins somewhat darker; peritoneum dark seal brown.

Type.—Cat. No. 74135, U.S.N.M., 27.5 cm. in length, taken with a beam trawl at station 5610 (lat. 0° 36′ 00″ S.; long. 122° 01′ 00″ E.), in the Gulf of Tomini, Celebes, at a depth of 678 fathoms, on a bottom of gray mud.

This species is named in honor of Dr. Samuel Garman in recognition of his noteworthy contributions to our knowledge of deep-sea fishes.

Genus BARATHRODEMUS Goode and Bean.

BARATHRODEMUS NASUTUS Smith and Radcliffe, new species.

Plate 10, fig. 2.

Dorsal 99; caudal 9; anal 81; ventrals 2; pectorals 24.

Head 4.78 (5.38 in total length), fleshy covering entirely concealing bony structure; body short, deep, so thin that the interneurals and interhæmals are discernible, strongly arched, greatest depth 4.25 (4.77 in total length); eye 6.40, small, elliptical oval; snout 4, much produced and dilated, overhanging mouth; mouth small, inferior, nearly horizontal, upper jaw overhanging lower; maxillary 2.28, short, almost entirely concealed by suborbital, posterior end dilated, truncate, extending beyond vertical from posterior margin of eye for 0.8 an eye-diameter; teeth small, villiform; patch on vomer broadly Λ-shaped; opercle armed with a single slender, sharp spine, almost entirely concealed by skin; preopercle unarmed, the fleshy skin covering both it and opercle continuous; pseudobranchiæ small, rudimentary; gill-filaments short; gill-rakers 4+19, those on upper arch and near end of lower arch reduced to small protuberances, the longest about 0.63 diameter of eye; no pyloric cœca; scales small, cycloid, persistent, entirely covering head and body, forming a scaly sheath at base of dorsal and anal, about 39 scales in a series from origin of anal to dorsal; the sculpturing of the scale essentially as in *Neobythites;* lateral line absent.

Dorsal and anal continuous with the caudal; distance of dorsal from tip of snout 4.50 (5.06 in total length); distance of anal from tip of snout 2.64 (2.96 in total length); ventrals small, each consisting

Digitized by Google

of 2 branched rays, separated at tip, the inner slightly longer, 2.60 in head, tips of rays expanded; ventral base behind tip of humeral symphysis; pectorals narrow, pointed, twice as long as ventrals.

Color in alcohol: Body sepia; sides, ventral surface of head, belly, and fins, slightly darker; peritoneum dark seal brown.

Type.—Cat. No. 74136, U.S.N.M., 17.2 cm. in length, taken with a beam trawl at station 5609 (lat. 0° 11′ 00″ S.; long. 121° 16′ 00″ E.), in the Gulf of Tomini, Celebes, at a depth of 1,092 fathoms, on a bottom of green mud.

The collection contains 2 smaller examples from the neighboring station 5608, taken at a depth of 1,089 fathoms.

Genus BASSOGIGAS Gill.

Bassogigas GILL MS., in Goode and Bean, Oceanic Ichthyology, 1895, p. 328, *pterotus*.

This genus is closely related to *Barathrodemus*, distinguished by the shorter snout which does not project beyond the terminal mouth and is not dilated; by the less elevated, more robust form of the body. The head is firmer, less spongy, the lower preopercular margin is free, the opercular spine is strong and each ventral is divided nearly to its base. Except for traces of a few rudimentary pores near head, the lateral line is indistinguishable.

BASSOGIGAS ÆQUATORIS Smith and Radcliffe, new species.

Plate 10, fig. 3.

Dorsal 104; caudal 9; anal 87; ventrals 2; pectorals 19.

Head 5.06 (5.65 in total length), bluntly rounded anteriorly, arched posteriorly, firmer than and not as fleshy as in *Barathrodemus;* body not strongly arched, somewhat compressed, greatest depth 6.07 (6.78 in total length); eye 6.80, small, elliptical-oval; snout 3.78, scarcely projecting beyond mouth; mouth of moderate size, subterminal, nearly horizontal, lower jaw included; maxillary 1.96, reaching an eye diameter beyond vertical from posterior margin of eye, posterior end dilated, truncate; teeth small, villiform, the patch on vomer broadly ∧-shaped; opercle armed with a single long, sharp pointed spine; preopercle unarmed; pseudobranchiæ consisting of 2 small filaments; gill-filaments short; gill-rakers 4+15, short, those on outer ends of arch reduced to small protuberances; pyloric cœca absent; scales small, cycloid, persistent, entirely covering head and body, fleshy bases of dorsal and anal covered with scales; about 32 scales in a series from origin of anal to dorsal; sculpturing of scales similar to that found in *Barathrodemus;* lateral line represented by a few rudimentary pores near head.

Dorsal and anal continuous with the caudal; distance of dorsal from tip of snout 4.30 (4.80 in total length); distance of anal from tip

Digitized by Google

of snout 2.45 (2.74 in total length); ventrals short, widely separated at base, each consisting of 2 superimposed divided rays, spatulate at tip, the upper ray longest, 2.55 in head; ventral base behind tip of humeral symphysis; pectorals narrow, pointed, elongate, 4.16 (4.65 in total length), tips reaching beyond base of anal; distance from base of lower pectoral rays to anal slightly greater than length of head.

Color in alcohol: Body burnt umber; head and belly with a grayish cast; fins and peritoneum dark seal brown.

Type.—Cat. No. 74137, U.S.N.M., 28.8 cm. in length, taken with a beam trawl at station 5608 (lat. 00° 08′ 00″ S.; long. 121° 19′ 00″ E.), in the Gulf of Tomini, Celebes, at a depth of 1,089 fathoms, on a bottom of gray mud.

This species may prove inseparable from *B. pterotus* of Alcock, but differs markedly from his description in having fewer rays in the dorsal and anal, and in the shorter distance between base of pectoral and first anal ray.

ENCHELYBROTULA Smith and Radcliffe, new genus.

A *Bassogigas*-like form, with a more elongate, anguilliform body. Mouth short, broad, teeth small, in a single series on jaws, vomer and palatines; eye small, deep-set; opercular spine feeble, covered with skin; pseudobranchiæ absent; gill-rakers few, small, tubercle-like; branchiostegals 7; ventral filaments bifid; stomach greatly elongated, opening of pylorus on mesial portion of its ventral surface, no pyloric cœca; urinary bladder exceedingly large.

Type of the genus.—*Enchelybrotula paucidens*, new species.

ENCHELYBROTULA PAUCIDENS Smith and Radcliffe, new species.

Plate 11, fig. 1.

Dorsal 125; caudal 10; anal 90; ventrals 2; pectorals 22.

Head 7.70 (8.42 in total length), short, bluntly rounded anteriorly, slightly arched posteriorly, angles of skull obscured by the thick fleshy skin; a row of small pores from upper angle of opercle extending forward nearly to eye, thence downward to maxillary, around lower margin of snout; other pores on lower lip, along margin of preopercle, and one on either side on occiput; body elongate, compressed, anguilliform, greatest depth 7.14 (7.82 in total length); eye 9.28 in head, 3 in interorbital, small, circular, very deep set in the alcoholic example, outside covering of skin transparent; snout 3.71, low, bluntly rounded, scarcely projecting beyond mouth; mouth short, broader than long, terminal; lower jaw included; maxillary 2.32, reaching slightly beyond vertical from posterior margin of eye, with a fleshy covering of skin; teeth small, reduced to a single series on jaws, vomer and palatines; opercular spine short, blunt, entirely covered by skin; preopercle unarmed, lower margin free; pseudobranchiæ absent; gills

Digitized by Google

4, a small slit behind the fourth; gill-filaments short; gill-rakers 4+5, reduced to slight protuberances; branchiostegals 7; pyloric cœca absent; stomach greatly elongated, opening to pylorus on lower mesial portion; urinary bladder greatly enlarged, nine-sixteenths as long as head, its breadth about 0.55 its length; scales long, elliptical oval, cycloid, persistent, entirely covering head and body; fleshy covering of dorsal and anal scaled, sculpturing as in related genera; lateral line indistinguishable, scales from origin of anal to dorsal 43, about 200 transverse rows between angle of opercle and base of caudal.

Dorsal and anal continuous with the caudal; distance of dorsal from tip of snout 6.42 (7 in total length); distance of anal from tip of snout 2.41 (2.64 in total length); both dorsal and anal covered with thick skin; ventrals long, each consisting of 2 divided rays, their basal portions joined together for a distance equal to twice diameter of eye, inner ray longest, a little longer than head, bases of ventrals close together, behind tip of humeral symphysis; pectorals short, acutely rounded, 1.30 in head; distance from base of lower rays to anal 3.57 (3.90 in total length).

Color in alcohol: Olivaceous; margin of opercle, lips, and fins slightly darker; the posterior rays of dorsal and anal and the caudal clove brown; peritoneum cinnamon, punctulate with darker.

Type.—Cat. No. 74138, U.S.N.M., 54.7 cm. in length, taken with a beam trawl at station 5608 (lat. 00° 08′ 00″ S.; long. 121° 19′ 00″ E.), in the Gulf of Tomini, Celebes, at a depth of 1,089 fathoms, on a bottom of gray mud.

Genus ERETMICHTHYS Garman.

ERETMICHTHYS REMIFER Smith and Radcliffe, new species.

Plate 11, fig. 2.

Dorsal 124; caudal 8; anal 100; ventrals 1; pectorals 26 (11+15).

Head 5.82 (6.32 in total length), flattened anteriorly, the loose fleshy covering obscuring the angles of the skull; body slender, strongly compressed posteriorly, greatest depth 7.46 (8.12 in total length); eye 8.60 in head, small, elliptical-oval, about one-third interorbital space, less than one-half length of snout; snout 3.91, broad, blunt, scarcely projecting beyond mouth; mouth wide, slightly oblique, the lower jaw included; maxillary 2.02, reaching an eye diameter beyond vertical from posterior margin of eye, largely concealed by suborbital, lower angle longer, acute; teeth in villiform bands on jaws, vomer, and palatines; opercular spine feeble; preopercle entire, produced backward nearly to posterior margin of opercle; pseudobranchiæ consisting of 2 small filaments; gill filaments short; gill-rakers 4+21, slender, the longest one and two-

Digitized by Google

thirds times as long as eye; pyloric cœca absent; scales small, deciduous, entirely covering head and body; lateral line indistinguishable.

Dorsal and anal continuous with the caudal; dorsal origin close to head, its distance from tip of snout 6.58 (7.16 in total length); caudal narrow, elongate, pointed; origin of anal a head-length behind base of lower pectoral rays, its distance from tip of snout about one-third standard length; ventrals simple, 1.26 in head, bases close together, behind tip of humeral symphysis; upper 11 pectoral rays shorter than head, lower rays greatly produced, less flexible, bound together and thickened near base, the longest 3.12 (3.40 in total length).

Color in alcohol: Cinnamon, darker shades on head and belly; fins light olivaceous; stomach and peritoneum dark chestnut brown.

Type.—Cat. No. 74139, U.S.N.M., 27.2 cm. long, taken with a beam trawl at station 5609 (lat. 00° 11′ 00″ S.; long. 121° 16′ 00″ E.), in the Gulf of Tomini, Celebes, at a depth of 1,092 fathoms, on a bottom of green mud.

Genus BASSOZETUS Gill.

BASSOZETUS ROBUSTUS Smith and Radcliffe, new species.

Plate 11, fig. 3.

Dorsal 120; caudal 9; anal 102; ventrals 1; pectorals 25.

Head 4.67 (5.14 in total length), its depth nearly twice its breadth, about 0.85 its length, large, compressed, depressed anteriorly, strongly arched posteriorly, bones soft and cavernous, a prominent internarial ridge, and a ridge near each side of interorbital space, these slightly diverging posteriorly, separated by a deep concavity, with a smaller concavity lying between ridges and eyes (in life these concavities were probably much less distinct), a distinct prominence above and behind each eye; body robust anteriorly, tapering regularly, greatest depth 5.45 (6 in total length); eye 10 in head, 2.64 in snout, small, elliptical-oval; snout 3.78, somewhat swollen, as broad as interorbital, not projecting beyond mouth; mouth large, oblique, lower jaw included, its tip when closed fitting into a toothless space between intermaxillary bands of teeth; maxillary 1.84, with a deep groove posteriorly, dilated behind to nearly twice diameter of eye, extending 2 eye diameters beyond vertical from posterior margin of eye, posterior margin sinuous, upper margin concealed under expanded suborbital; teeth small, sharp, in broad bands on jaws, vomer, and palatines; band on vomer broadly ∧-shaped, each arm being bent with the convexity inward; tongue large, broad and pointed, margins thin, tip reaching within slightly more than an eye diameter of tip of mandible; opercular spine very feeble, broad, flat, covered with skin not extending as far backward and not nearly as

Digitized by Google

distinct as in *B. compressus;* preopercle unarmed, broadly rounded, its upper margin oblique; both opercle and preopercle with radiating striæ; pseudobranchiæ consisting of two short, thick, filaments; gill filaments short, 12 well developed gill-rakers on lower arch, the longest 1.4 times diameter of eye; no pyloric cœca; scales small, deciduous, covering head and body, and fleshy bases of dorsal and anal; about 32 scales in a series from origin of anal to dorsal (the scales are lost, but appear to have been smaller than in other described forms); lateral line indistinguishable.

Dorsal and anal continuous with the caudal; dorsal origin close to head, its distance from tip of snout 4.95 (5.46 in total length); caudal narrow, elongate, pointed; origin of anal about 0.66 length of head behind base of lower pectoral rays, its distance from tip of snout 2.77 (3.05 in total length); ventrals simple, 1.20 in head, tips reaching to vent, bases close together, behind tip of humeral symphysis; pectorals simple, about 1.63 in head.

Color in alcohol: Back and sides of body buff; belly with dusky black shades; head gray, blackish underneath; opercles, branchiostegals and lips blackish; fins dusky; inside of mouth grayish; inside of gill-coverings and peritoneum dark chestnut brown; fins dusky; marginal portion of dorsal and anal darker than basal portion.

Type.—Cat. No. 74140, U.S.N.M., 36 cm. in length, taken with a beam trawl at station 5349 (lat. 10° 54′ 00″ N.; long. 118° 26′ 20″ E.), in Palawan Passage, at a depth of 730 fathoms, on a bottom of coral and sand.

In this species the scales are smaller, the ventrals longer, the body more robust, opercular spine weaker and coloration lighter than in the type of *B. compressus* Günther. His example, 5.5 inches long, taken at station 205, Philippine Islands, had longer ventrals as in *robustus* and may have been this species.

BASSOZETUS ELONGATUS Smith and Radcliffe, new species.

Plate 11, fig. 4.

Dorsal 118; caudal 10; anal 102; ventrals 1; pectorals 22.

Head 5.43 (5.86 in total length), its depth less than twice its breadth about 0.75 its length; compressed, depressed anteriorly, arched posteriorly, bones soft and cavernous; ridges on head prominent, arranged as in *robustus;* body slender, compressed, elongate, tapering regularly, greatest depth 7.41 (8 in total length); eye 12.1 in head, 2.64 in snout, small, elliptical-oval; snout 4.55, swollen, slightly broader than interorbital, not projecting beyond mouth; mouth large, oblique, lower jaw included; maxillary 1.91, hollowed out and dilated posteriorly, its greatest breadth equal to its projection beyond vertical from posterior margin of eye, more than twice diameter of eye, slipping for nearly its entire breadth under expanded

Digitized by Google

suborbital bones; teeth small, sharp, in broad bands on jaws, vomer and palatines; band on vomer similar to that in *B. robustus*, except that the head of the vomer projects downward much more strongly; tongue not as broad as in *robustus*, margins rounded, tip pointed, its distance from tip of mandible 1.7 times diameter of eye; opercular spine feeble, covered with skin, extending nearly to tip of opercular flap; preopercle unarmed, more evenly rounded than in *robustus;* pseudobranchiæ consisting of 2 short filaments; gill-filaments very short; 16 long, well-developed gill-rakers on lower arch, the longest 1.7 times diameter of eye; pyloric cœca absent; scales large, deciduous, covering head and body and fleshy bases of dorsal and anal; it is impossible to determine accurately their number, but there appear to have been between 16 and 20 between origin of anal and dorsal; lateral line indistinguishable.

Dorsal and anal continuous with the caudal; dorsal origin close to head, its distance from tip of snout 5.63 (6.08 in total length); caudal very narrow and elongate; origin of anal about 0.7 length of head behind base of lower pectoral rays, its distance from tip of snout 3.10 (3.33 in total length); ventrals simple, about 1.90 in head, bases close together behind tip of humeral symphysis; pectorals about 1.90.

Color in alcohol: Body hair brown, becoming blackish on belly; head plumbeous, blackish underneath, darkest on opercles, branchiostegals and lips; fins dusky; inside of mouth grayish; inside of gill-covering and peritoneum dark chestnut brown; stomach brownish.

Type.—Cat. No. 74141, U.S.N.M., 48 cm. in length, taken with a beam trawl at station 5608 (lat. 0° 08′ 00″ S.; long. 121° 19′ 00″ E.), in the Gulf of Tomini, Celebes, at a depth of 1,089 fathoms, on a bottom of gray mud.

This species differs from *B. robustus* in the feebler bony structure of the head, the slenderer, more elongate body, larger scales, and greater prominence of the vomer, smaller tongue, smaller eye, shorter ventrals, and darker coloration.

MASTIGOPTERUS Smith and Radcliffe, new genus.

Body mixoniform, tapering gradually into the long, slender tail; head large, thick, with large sinuses and pores; bones of head heavy, firm; jaws nearly equal; teeth in narrow villiform bands in jaws and on vomer, in broad bands on palatines; pseudobranchiæ absent; 10 well-developed gill-rakers on first arch; branchiostegals 8; pyloric cœca rudimentary; operculum armed with a thin, flat, triangular spine, nearly concealed by scales; dorsal fin higher than anal; caudal fin elongate, of few rays on a very narrow base; pectoral fins of 10 rays, greatly produced, more than half total length, basal portion narrow, constricted, thickened, distal portion filamentous, the rays more or less separated; ventral filaments long, each composed of 2

Digitized by Google

nearly equal rays divided nearly to base; scales small, cycloid, covering head and body; lateral line indistinguishable.

Type of the genus.—*Mastigopterus imperator*, new species.

MASTIGOPTERUS IMPERATOR Smith and Radcliffe, new species.

Plate 12, fig. 1.

Dorsal 142; caudal 6; anal 130; ventrals 2; pectorals 11.

Head 5.42 (6.01 in total length), massive, arched posteriorly, large sinuses, more or less covered with transparent membrane, on infraorbital, mandible, and preopercle; a row, of small pores extending over nape, another from upper angle of operculum to upper margin of eye, 3 pores on posterior part of interorbital; 2 large pores between anterior and 2 smaller ones between posterior nostrils; greatest breadth of head 1.4 in its depth; body robust, compressed posteriorly, tapering into a long, filamentous tail, greatest depth 5.54 (6.15 in total length); eye 7.42, moderate, elliptical-oval, high, directed slightly upward; snout 3.95, broad, little depressed, evenly rounded, not projecting beyond mouth; mouth large, oblique, lower jaw included; maxillary 1.82, strong, reaching an eye-diameter beyond vertical from posterior margin of eye, posterior end expanded, 1.5 times as long as eye, lower angle longer, acute; teeth small, villiform, in very narrow bonds on jaws and vomer, the vomerine patch crescent-shaped; band on right palatine bone nearly 0.5 as broad as long, broadest at the middle, anterior end broadly truncate; patch on left palatine with its inner margin strongly convex and with a deep incision near anterior end; interorbital 3.30, broad flattened, 2.25 times eye; nareal apertures large; opercle armed with a thin, flat triangular spine; preoperculum rounded, angle and horizontal margin with minute serrations; pseudobranchiæ absent; gill-filaments short; gill-rakers 4+15, 10 on lower limb prolonged, the longest nearly equal to eye; traces of several small, rudimentary pyloric cœca; scales small, deciduous, covering head and body, and basal portions of dorsal, anal, and pectoral, about 45 in a row from origin of anal to dorsal; lateral line indistinguishable.

Dorsal and anal continuous with the caudal; dorsal fin much higher than the anal, the longest as long as snout plus eye; dorsal origin above base of pectoral, its distance from tip of snout 4.68 (5.20 in total length); caudal fin of few rays on a very narrow base longest rays more than 0.5 as long as head; origin of anal from tip of snout 2.65 (2.94 in total length), its rays shorter than those of the dorsal; ventrals bifid, inner ray slightly longer, 1.25 times as long as head, its tip reaching to vent; pectorals narrow at base, greatly produced, basal portion stiffened, the rays closely bound together, distal portion whip-like, the rays more or less separated, the longest more than 3.5 times as long as head, 1.48 (1.65 in total length).

Digitized by Google

Color in alcohol: Body light clay, grayish white beneath scales; top of head pearl gray, cheeks and lips écru drab; opercle with blackish shades underneath; branchiostegals, inside of gill-cavity, and peritoneum dark seal brown; caudal, posterior rays and margin of anterior rays of dorsal and anal clove brown, outer pectoral rays dusky, remainder of fins body color.

Type.—Cat. No. 74142, U.S.N.M., 53.5 cm. in length, taken with a beam trawl at station 5495 (lat. 9° 06′ 30″ N.; long. 125° 00′ 20″ E.), between Leyte and Mindanao, at a depth of 976 fathoms, on a bottom of gray mud.

MASTIGOPTERUS PRÆTOR Smith and Radcliffe, new species.

Plate 12, fig. 2.

Dorsal 131; caudal 6; anal 115; ventrals 2; pectorals 11.

Head 5.85 (6.51 in total length), dorsal outline relatively straight, very large sinuses on infraorbital, preopercle, and mandible; pores on top of head small, arranged as in *imperator;* greatest breadth of head two-thirds of its depth; body compressed, tapering into a long, slender tail, greatest depth 6.51 (7.24 in total length); eye 5.36, large, elliptical-oval, lateral; snout 3.93, low, rather pointed, not projecting beyond mouth; mouth large, slightly oblique; maxillary 1.73 extending 0.5 an eye diameter beyond vertical from posterior margin of eye, posterior end somewhat expanded, its breadth equal to diameter of eye; teeth small, villiform, in narrow bands on jaws and vomer, vomerine patch ∩-shaped; palatine bands broad, as in *imperator,* inner margin anteriorly incised; tongue thick and fleshy; interorbital 3.28, flattened, about 1.6 times eye; opercle armed with a very thin flat spine, concealed by scales covering opercle; preoperculum unarmed; pseudobranchiæ absent; gill-filaments very short; gill-rakers 5+15, 10 on lower arch prolonged, slender, the longest about three-fourths diameter of eye; pyloric cœca small, rudimentary; scales small, somewhat deciduous, covering head and body, and basal portions of dorsal, anal and pectoral, between 40 and 45 in a row from origin of anal to dorsal; lateral line indistinguishable.

Dorsal and anal continuous with the caudal; dorsal high, the longest rays slightly greater than snout plus eye; origin of dorsal above base of pectoral, its distance from tip of snout 5.48 (6.10 in total length); ventrals bifid, tips filamentous, the inner longer, 1.25 times as long as head, its tip reaching vent; pectorals narrow, similar in form to those of *imperator,* longest ray about 4.5 times as long as head.

Color in alcohol: Clay, grayish-white underneath scales; cheeks, lips and pectorals écru drab; opercle with blackish shades underneath; caudal, posterior rays and margin of anterior rays of dorsal and anal clove brown; peritoneum dark seal brown.

Digitized by Google

Type.—Cat. No. 74143, U.S.N.M., 38.4 cm. in length, taken with a beam trawl at station 5628 (lat. 00° 28′ 30″ S.; long. 127° 45′ 00″ E.), in Patiente Strait, at a depth of 1,291 fathoms, on a bottom of gray mud.

This species is distinguished from *imperator* by the slenderer form of head and body, more conspicuous sinuses and pores on head, larger eye and correspondingly narrower interorbital, less deeply bifid ventrals, longer pectorals and fewer rays in the dorsal and anal.

Genus GLYPTOPHIDIUM Alcock.

GLYPTOPHIDIUM LUCIDUM Smith and Radcliffe, new species.

Plate 12, fig. 3.

Dorsal 118; caudal 11; anal 100; ventrals 1; pectorals 24.

Head 4.73 (4.95 in total length), large compressed, subquadrate in cross-section, somewhat arched posteriorly, cavernous, with thin, well marked crests as in species of the macrourid genus *Hymenocephalus;* body compressed, tapering into a long slender tail; greatest depth 5.50 (5.75 in total length); eye 3, large, elliptical-oval, orbital rims greatly expanded; snout 4.04 in head, 1.36 in eye; 1.24 in interorbital, short, blunt, depressed, with a distinct median ridge; mouth large, oblique, lower jaw included; maxillary 1.86, barely reaching vertical from posterior margin of eye, slipping under expanded suborbital; bands of small villiform teeth on jaws, vomer, and palatines; vomerine patch ∩-shaped; interorbital 3.32, broad, flattened; opercle armed with a weak spine; preopercle with 2 small spines near angle; pseudobranchiæ represented by about 10 short filaments; gill-filaments short; gill-rakers 5+20, the longest less than 0.33 diameter of eye; about 6 short rudimentary appendages around pylorus; scales small, cycloid, more persistent than in *G. argenteum;* the frilled and crested bones of head apparently scaled in life; lateral line indistinguishable.

Dorsal and anal continuous with the caudal; origin of dorsal from tip of snout 4.76 (5 in total length); anal rays shorter than those of dorsal; origin of anal 2.82 (2.95 in total length); ventrals 1.72, longer than in *argenteum*, each composed of a simple filament, bases close together in advance of vertical from insertion of dorsal; pectoral 1.50.

Color in alcohol: Body ochraceous buff, with silvery glints and dusky punctulations (much lighter than *argenteum*); head and belly cream buff, a dusky brown area at base of dorsal, dusky coloration most distinct on the base of each ray; fins light gray, more or less translucent; stomach and long, coiled intestine slate gray.

Type.—Cat. No. 74144, U.S.N.M., 23 cm. in length, taken with a beam trawl at station 5625 (lat. 00° 7′ 00″ N.; long. 127° 28′ 00″ E.),

Digitized by Google

between Gillolo and Kayoa Islands, Dutch East Indies, at a depth of 230 fathoms, on a bottom of gray mud and fine sand.

With the exception of one specimen, which came from Palawan Passage, all of our examples were taken in the region of Gillolo Island. All of our examples of *G. argenteum* are from the interisland waters of the Philippine Archipelago, and are readily separable from this species, having a much darker coloration, smaller eye, the frill-like bony crests of the head less firm, and the ventrals shorter.

GLYPTOPHIDIUM OCEANIUM Smith and Radcliffe, new species.

Plate 12, fig. 4.

Dorsal 128; caudal 9; anal 90; ventrals 2; pectorals 23.

Head 4.81 (5 in total length), rather more pointed and depressed than in related species, crests firmer; body slender, compressed, tapering into a slender tail; greatest depth 5.94 (6.18 in total length); eye 3.23, large, broadly elliptical-oval; orbital rims expanded, scarcely as prominent as in *lucidum*; snout 3.65 in head, 1.13 in eye, equal to interorbital, rather blunt, median dorsal ridge distinct; mouth large, oblique, upper jaw overlapping lower, except at tip, where the knob at tip of mandibular symphysis projects slightly; maxillary 1.79, scarcely reaching vertical from posterior margin of eye, slipping under expanded suborbital; bands of small villiform teeth on jaws, vomer and palatines; interorbital flattened, slightly concave in the alcoholic examples; nostrils widely separated, anterior on anterior margin of snout, posterior close to eye; opercular spine slender, slightly stronger than in examples of *lucidum*, a weak incision above angle of preopercle; pseudobranchiæ represented by 12 to 14 short filaments; gill-filaments short; gill-rakers long and slender, 9+27, the longest one-half diameter of eye; about 8 slender appendages around pylorus, better developed than in *lucidum;* scales small, cycloid, deciduous; lateral line indistinguishable.

Dorsal and anal continuous with the caudal; the dorsal more anterior in its insertion than in *lucidum*, its distance from tip of snout 5.46 (5.68 in total length); anal rays much shorter than those of dorsal; distance of anal from tip of snout 2.52 (2.62 in total length); ventrals consisting of 2 slender rays divided nearly to base, inner ray longest, 2.20 in head, bases close together in vertical from origin of dorsal; pectoral 1.62.

Color in alcohol: Body raw sienna, darkest dorsally; head and belly somewhat lighter with silvery reflections; fins grayish, rays punctulate with darker, especially the distal portion of anterior dorsal rays; gill-rakers and lining of gill-chamber adjacent to gills seal-brown; on gill-chamber this is margined with silvery; peritoneum seal-brown; stomach and intestine dark clove-brown.

Digitized by Google

Type.—Cat. No. 74145, U.S.N.M., 21 cm. in length, taken with a beam trawl at station 5444 (lat. 12° 43′ 51″ N.; long. 124° 58′ 50″ E.), in the Pacific Ocean north of Samar, at a depth of 308 fathoms, on a bottom of green mud.

The collection contains 2 other examples, 1 from station 5298, Batangas Bay, Luzon, at a depth of 140 fathoms, and 1 from station 5331, west coast of Luzon, at a depth of 178 fathoms.

This species is distinguished from the other Philippine forms in having the ventrals bifid. It appears to be more closely related to *G. macropus* of Alcock, from which it is distinguished by the much shorter ventral filaments, these being only about 0.5 as long as head (in *macropus*, Alcock states that their length is an eye diameter longer than head, and Brauer gives them as 1.5 to 2 times the length of the head), and by the larger number of pseudobranchial filaments, 12 to 14 (5 to 8 in *macropus*). The snout is longer and the interorbital narrower than in Brauer's examples of *macropus*.

Genus LAMPROGRAMMUS Alcock.

LAMPROGRAMMUS MACROPTERUS Smith and Radcliffe, new species.

Plate 13, fig. 1.

Dorsal, 120; anal, 103; caudal, 9; pectoral, 21.

Head 4.77 (5.05 in total length), compressed, nearly as deep as long, covered by thin scales and by mucous channels under the skin, the scales more persistent than in *niger;* body deep, much compressed, greatest depth 5 (5.28 in total length); eye 7.30 in head, 2.03 in snout, 2.10 in interorbital, lateral, subcircular, orbital bones less prominent than in *niger;* snout 3.60, broad, blunt, depressed, not projecting beyond mouth; mouth large, oblique, lower jaw included; maxillary 1.86, longer than in *niger*, reaching nearly an eye-diameter beyond vertical from posterior margin of eye, its upper and hinder edges concave, its greatest breadth 1.35 times diameter of eye; bands of villiform teeth on jaws, vomer, and palatines, those on intermaxillary broad, those on mandible somewhat narrower, especially anteriorly, but broader than in *niger;* vomerine patch Λ-shaped, broader than in *niger*, especially at the head of the vomer; interorbital 3.49, convex, narrower than in other forms; nareal apertures small, close together; opercle armed with a thin, flat spine, all except the tip concealed by skin; preopercle with a slight emargination near the angle as in *niger;* no pseudobranchiæ; gill-filaments short; gill-rakers 3+15, well developed, flattened, longest nearly equal to diameter of eye; 2 short, stout rudiments of pyloric cœca; scales small, cycloid, without radiating striæ (differing in this respect from *niger*), covering head and body and bases of dorsal, anal, and pectorals; lateral line inconspicuous, not as wide as eye, the inner

Digitized by Google

plate-like scales much less distinct than in other described forms and the band of small scales covering plates more nearly equal in size to those above and below.

Dorsal and anal continuous with the caudal; origin of dorsal slightly in advance of base of pectoral, its distance from tip of snout slightly greater than length of head, 4.52 (4.78 in total length); origin of anal three-fourths of a head length behind base of lower pectoral rays, its distance from tip of snout 2.51 (2.66 in total length); ventrals absent; pectoral 1.72 in head, broader, and having more rays than other described forms.

Color in alcohol: Clove brown, fins and branchiostegal membranes somewhat darker; inside of gill-covers and peritoneum dark seal brown.

Type.—Cat. No. 74146, U.S.N.M., 54.5 cm. in length, taken with a beam trawl at station 5648 (lat. 5° 35′ 00″ S.; long. 122° 20′ 00″ E.), in Buton Strait, at a depth of 559 fathoms, on a bottom of green mud.

The greater number of rays in dorsal, anal, and pectoral; the firmer texture of the scaly skin of head and body rendering the crests of head and the enlarged plates of lateral line much less conspicuous; the outer band of small scales covering plates scarcely differentiated from those above and below; and the character of the teeth distinguish this species from other known forms.

HYPOPLEURON Smith and Radcliffe, new genus.

Body slender, elongate, *Catætyx*-like, covered with small cycloid scales; head low, depressed, elongate, scaled; teeth on mandible in a narrow band, villiform, some of those in outer row somewhat enlarged; a pair of small canine-like teeth on either side of symphysis of upper jaw, premaxillary band villiform; patch on vomer ∩-shaped, some of the teeth enlarged; band on palatines narrow with a few enlarged teeth; eyes lateral, high; opercle and preopercle unarmed. Vertical fins united; ventrals very small, simple, close together, situated behind tip of humeral symphysis; pectorals elongate, narrow. Gills 4, gill-filaments well developed, only 3 developed gill-rakers on first arch; pseudobranchiæ present. Branchiostegals 8. Pyloric cœca well developed. Lateral line broad anteriorly, narrowing posteriorly and disappearing on tail, structurally very much like *Lamprogrammus*, possessing the outer band of small scales pierced at regular intervals by pores, and an inner series of enlarged plate-like scales.

Parapophyses of abdominal vertebræ broadened, lengthened, and bent inward at ends and sides, the whole forming a large bony case containing the air bladder; the thickened ventral wall of the latter connecting the free ends of the parapophyses; ribs of the vertebræ which

Digitized by Google

bear the enlarged parapophyses greatly reduced, mere rudiments, the ends of median ones coalescent with the parapophyses. The accompanying photographs are from the type. (Pl. 14.) The nearest approach to this remarkable development of the vertebræ is found in the hake (*Merluccius*), and two photographs of the abdominal vertebræ of *Merluccius productus* (Cat. No. 26495, U.S.N.M.) from Monterey, California, are shown for comparative purposes. (Pl. 15.)

Type of the genus.—Hypopleuron caninum, new species.

HYPOPLEURON CANINUM Smith and Radcliffe, new species.

Plate 13, fig. 2; plate 14, 3 figs.

Dorsal 160; caudal 12; anal 122; ventrals 1; pectorals 24.

Head 5.12 (5.18 in total length), low, pointed, depressed, elongate, dorsal contour nearly horizontal, greatest breadth about 1.4 times greatest depth; body slender, elongate, strongly compressed posteriorly, greatest depth 8.28 (8.52 in total length); eye 6.78 in head, 1.68 in snout, 1.42 in interorbital, high, lateral, elliptical-oval; snout 4.05, depressed, pointed; mouth large, oblique, lower jaw narrow, projecting beyond tip of upper; maxillary 2.39, reaching vertical from posterior margin of eye, expanded posteriorly, greatest breadth equal to diameter of eye; mandibular teeth in narrow bands, small, villiform, interspersed with a few slightly enlarged teeth on sides, premaxillary band of teeth somewhat wider, villiform, a pair of small, incurved canine teeth on anterior margin, vomerine teeth unequal, in a ∩-shaped patch; palatine band narrow, a few enlarged teeth present; interorbital 4.78, broad, flattened; nostrils close together, anterior circular, with a raised margin; opercle and preopercle unarmed; pseudobranchiæ present, consisting of about 6 small filaments; gills 4, a slit behind the fourth; gill-filaments well developed, only 3 gill-rakers developed on anterior arch; branchiostegals 8; stomach nearly as long as head; pyloric cœca well developed, about 10 in a row along each side of gut adjacent to the pylorus; the abdominal vertebræ with strongly expanded dipper-shaped parapophyses, extending slightly downward and outward as in *Merluccius*, thence inward forming a bony case nearly enclosing cavity normally occupied by air bladder; the margin of each parapophysis strongly infolded, forming a cup shaped pocket; mesially the tips of the ribs are coalesced with the parapophyses, on the ninth vertebra the tip of the slender rib is free, at about the thirteenth the rib is entirely free; the free ends of the parapophyses are united by a thick walled integument; this structure as is the case in species of *Merluccius* represents the ventral wall of the air bladder so that in *caninum* it is confined within the bony case formed by the expanded parapophyses; scales small, cycloid, somewhat deciduous; tip of snout and a narrow area including nostrils and extending backward

Digitized by Google

to eye, and the fold at upper angle of opercular flap, naked; lateral line anteriorly nearly 0.33 diameter of eye in width, narrowing posteriorly, disappearing at about 0.5 a head length from base of caudal; structurally it resembles *Lamprogrammus*, having an outer band of small scales, pierced at regular intervals by pore-like structures, and underneath a single row of enlarged, plate-like scales.

Dorsal and anal continuous with the caudal; origin of dorsal a head length behind tip of snout; distance of anal from tip of snout 2.22 (2.28 in total length); ventrals short, simple, about equal to diameter of eye, bases close together inserted behind humeral symphysis; pectoral 1.41 in head, long, narrow, its tip extending more than halfway to origin of anal.

Color in alcohol: Back and sides raw umber; belly straw yellow, punctulate with black dots; vertical fins similar to adjacent body color, punctulate with black, the black margin of the dorsal and anal widening posteriorly to include entire fin; pectoral dusky.

Type.—Cat. No. 74147, U.S.N.M., 57 cm. in length, taken with a beam trawl at station 5626 (lat. 00° 07′ 30″ N.; long. 127° 29′ 00″ E.), near Kayoa Island, Dutch East Indies, at a depth of 265 fathoms, on a bottom of gray mud and fine sand.

There are two small examples in the collection which appear to be referable to this species, one 22 cm. long from station 5372 (150 fathoms) near Marinduque Island, west coast of Luzon, the second 18.9 cm. long, from station 5523, between Negros and Mindanao.

The form and structure of this fish indicate that it is a very active species, not confining itself to the bottom regions. The body is firm and the pectorals are large and powerful. The exposed ventral wall of the air bladder is thick and muscular, attached at the sides to the roughened ends of the parapophyses; inside the bony case the wall is thin. Each of the hollow parapophyses was filled with a dark reddish mass undoubtedly rich in capillaries. It seems highly probable that this remarkable structure was of use to the fish in accommodating itself to rapidly changing conditions of pressure.

Genus DIPLACANTHOPOMA Günther.

In his description of the genus Günther[1] says: "Gills four, with lanceolate, widely-set gill-rakers and well-developed laminæ. Pseudobranchiæ none." The Philippine species has small gill-filaments, only 3 developed gill-rakers on the first arch, the remaining gill-rakers reduced to small knob-like protuberances; pseudobranchiæ present, consisting of 2 small filaments; armature of operculum not unlike that of many other brotulids, the lower plate-like spine being a little more in evidence because of the absence of a covering of scales, but not a true spine as shown in the illustration of the type

[1] Deep-Sea Fishes, *Challenger* Report, 1887, p. 115.

Digitized by Google

of *Diplacanthopoma;* margin of preopercle partially free; dorsal and anal with a fleshy, scaleless sheath extending nearly to tips of rays anteriorly; ventral filaments simple, each composed of 2 closely bound rays; pyloric cœca indistinguishable; branchiostegals 8; head covered with a fleshy scaleless skin, with a few minute, scattered cilia.

Lloyd [1] has examined the types of *D. rivers-andersoni* and *raniceps* of Alcock and finds pseudobranchiæ present, represented by two very short, slender filaments. These species agree closely with the Philippine form. If the characters for *Diplacanthopoma* are correctly given, there would seem to be no doubt that these forms are at least subgenerically distinct. For them the name *Sarcocara* (new subgeneric name) is proposed, based on the Philippine species herein described.

DIPLACANTHOPOMA (SARCOCARA) BRUNNEA Smith and Radcliffe, new species.

Plate 13, fig. 3.

Dorsal 134; caudal 6; anal 104; ventrals 1; pectorals 25.

Head 3.67 (3.92 in total length), large, depressed anteriorly, arched posteriorly, covered with a thick scaleless skin, the line of demarcation between head and body very distinct; body compressed, elongate, greatest depth 4.93 (5.26 in total length), eye 5.10, elliptical-oval; snout 4.40, depressed, slightly longer than eye; mouth large, oblique, lower jaw included; maxillary 2.27, reaching 0.4 of an eye diameter beyond vertical from posterior margin of eye, its upper margin concealed under expanded suborbital; bands of small villiform teeth on jaws, vomer, and palatines, a few teeth near symphysis of upper and lower jaw, and on vomer slightly enlarged, the mandibular patch slightly narrower than that on intermaxillaries, the patch on vomer broadly Λ-shaped; interorbital 3.64, broader than eye, flattened; anterior nostril with a collar-like margin, situated close to edge of snout, posterior nostril large, close to eye; opercle armed with a long, slender spine at angle, a small spine-like projection opposite angle of preopercle, these 2 diverging opercular spines being connected by a thin, plate-like structure; this structure is developed to a greater or less degree in other brotulids, but is usually much less distinct, being covered by scales; preopercle unarmed; pseudobranchiæ consisting of 2 small filaments; gill filaments very short; 3 of the gill-rakers at angle of arch moderately developed, the rest reduced to knob-like protuberances; no pyloric cœca; scales small, cycloid; head naked; bases of dorsal and anal concealed in a thick scaleless skin, similar to that covering head; lateral line rudimentary, traces of pores anteriorly.

Dorsal and anal continuous with the caudal; origin of dorsal over axil of pectoral, its distance from tip of snout 3.28 (3.51 in total

[1] Records of the Indian Museum, vol. 1, pt. 1, 1907, p. 10; Memoirs of the Indian Museum, vol. 2, No. 3, 1909, p. 165.

Digitized by Google

length); distance of anal from tip of snout 2.12 (2.27 in total length), its distance from base of lower pectoral rays 1.34 in head; ventrals 2.22 in head, short, each consisting of 2 closely bound rays; bases of ventrals close together, behind humeral symphysis, more than a head-length in advance of origin of anal; pectoral 1.82, narrow.

Color in alcohol: Body Broccoli brown; top and sides of head and fleshy covering of bases of vertical fins light chestnut; under side of head whitish; inside of gill-cover light chestnut; peritoneum dark chestnut.

Type.—Cat. No. 74148, U.S.N.M., 20 cm. in length, taken with a beam trawl at station 5348 (lat. 10° 57′ 45″ N.; long. 118° 38′ 15″ E.), in Palawan Passage, at a depth of 375 fathoms, on a bottom of coral and sand.

Genus GRAMMONUS Gill.

The Philippine species which we have assigned to this genus differs from *Sarcocara* in having the body relatively short and deep, the tail not attenuated; the scales persistent, present on cheeks, opercle and occiput; no palatine teeth; eyes slightly upturned; a single opercular spine visible; preopercle well ossified, with a broad obtuse angled point on its posterior margin; lateral line distinct, interrupted mesially, the 2 parts overlapping the same vertical; a short but broad flap-like appendage on each side of the pylorus; dorsal rays about 84; anal about 60.

GRAMMONUS ROBUSTUS Smith and Radcliffe, new species.

Plate 13, fig. 4.

Dorsal 84; caudal 9; anal 60; ventrals 1; pectorals 25; scales about 14+24–80.

Head 3.51 (3.87 in total length), broad, depressed anteriorly, strongly arched posteriorly, a few small cilia present; body short, deep, compressed posteriorly, greatest depth 3.82 (4.21 in total length) eye 5.70 in head, 1.38 in snout, small, circular, dorso-lateral; snout 4.12, low, wide, bluntly rounded; mouth large, slightly oblique, lower jaw included; maxillary 1.68, extending for more than an eye diameter beyond vertical from posterior margin of eye, upper margin slipping under suborbital, posterior end expanded, truncate, 1.23 times diameter of eye; a narrow band of villiform teeth on mandible, a somewhat broader band of similar teeth on premaxillary, each arm of patch on vomer slightly incurved, palatine teeth absent; interorbital width equal to snout, broad, flat; opercle armed with a rather stout spine, nearly concealed by a scaly sheath; preopercle well ossified, a broad obtuse-angled point on its posterior margin; pseudobranchiæ consisting of 2 small filaments; gill-filaments short; 3 developed gill-rakers on first arch; branchiostegals 8; a broad

Digitized by Google

flaplike appendage on each side of the pylorus; scales small, cycloid, persistent; cheeks, opercles, and occiput covered with small inconspicuous scales, rest of head naked; lateral line distinct, interrupted in the middle, the 2 parts overlapping the same vertical.

Dorsal and anal continuous with the caudal, their bases sheathed with thin membranous skin; distance of origin of dorsal from tip of snout 2.85 (3.15 in total length); caudal narrow; distance of anal from tip of snout 1.80 (1.98 in total length); ventrals 2.47 in head, each composed of 2 rays closely united throughout their length, bases of ventrals close together; pectorals 1.40.

Color in alcohol: Wood-brown; dorsal and anal dusky anteriorly, becoming dark clove brown posteriorly; the basal portion of caudal clove brown, distal portion somewhat lighter; pectorals dusky; peritoneum silvery gray.

Type.—Cat. No. 74149, U.S.N.M., 14.3 cm. in length, taken with a beam trawl at station 5409 (lat. 10° 38′ 00″ N.; long. 124° 13′ 08″ E.), between Cebu and Leyte, at a depth of 189 fathoms, on a bottom of green mud.

Genus CATÆTYX Günther.

The Philippine species differs from *Sarcocara* in having the body slender, less attenuated, the head markedly depressed, porous; cheeks and opercle (and top of head posteriorly in the young) scaled; eyes superior; lower opercular spine very indistinct, covered with scales; a short but broad flaplike appendage on each side of the pylorus; scales persistent; dorsal about 100; anal about 70.

Diplacanthopoma squamiceps Lloyd [1] from the southeastern coast of Arabia should be included in the genus as characterized above.

CATÆTYX PLATYCEPHALUS Smith and Radcliffe, new species.

Plate 16, fig. 1.

Dorsal 98; caudal 11; anal 68; ventrals 1; pectorals 22.

Head 4.08 (4.61 in total length), long, low-depressed, its width at eyes greater than its depth; outline of dorsal surface longitudinally very slightly concave, laterally broadly convex; a series of large pores on lower suborbital region, preopercle and mandible, 3 large pores in a line between eye and shoulder, 2 on top of head behind eye, 1 between eyes, and 2 in front of eyes; body slender, strongly compressed posteriorly, greatest depth 6.12 (6.92 in total length), 1.52 in head; eye 5.13, small, superior; snout 4.70, slightly longer than eye, broad and bluntly rounded; mouth wide, oblique, jaws subequal; maxillary 2.45, extending beyond vertical from posterior margin of eye, upper margin slipping under suborbital; small, equal

[1] Lloyd, Records of the Indian Museum, vol. 1, pt. 1, 1907, p. 10; Illustrations of the Zoology of the *Investigator*, Fishes, pl. 42, fig. 2, 2a, 1908, and Memoirs of the Indian Museum, vol. 2, No. 3, 1909, p. 165.

Digitized by Google

villiform teeth in bands on jaws, vomer, and palatine; vomerine patch broadly Λ-shaped; interorbital 8.06, very narrow and flat; anterior nostril tubular, on anterior margin of snout, posterior larger, near eye; opercle armed with a long slender spine, preopercle unarmed; pseudobranchiæ consisting of 2 small filaments; gill-filaments short; 3 of the gill-rakers at angle of arch moderately developed, the others reduced to knoblike protuberances, as in *D.* (*Sarcocara*) *brunnea;* pyloric cœca two, short and thick, one on either side of the pylorus; ovaries large, fusiform, the wall thin and translucent; scales of moderate size, 26 in a row from origin of anal to dorsal; cheek and opercle scaled, those on post-orbital part of head apparently lost with age; traces of rudimentary pores parallel with the back to a point above vent, thence along middle of side to base of caudal; branchiostegals 8.

Dorsal and anal continuous with the caudal, origin of dorsal behind axil of pectoral, its distance from tip of snout 3 (3.21 in total length); origin of anal slightly nearer tip of snout than tip of caudal; ventrals 2.17, each consisting of 2 closely bound rays, bases close together behind humeral symphysis, much more than a head length in advance of origin of anal; pectoral 1.86, narrow.

Color in alcohol: Clay, the dark coloration of the peritoneum and lining of the gill-cavity showing through on belly and opercle; peritoneum brownish black.

Type.—Cat. No. 74150, U.S.N.M., 13 cm. in length, taken with a beam trawl at station 5618 (lat. 00° 37′ 00″ N.; long. 127° 15′ 00″ E.), in Molucca Passage, at a depth of 417 fathoms, on a bottom of gray mud.

The type is a gravid female. The eggs are large and are contained in a large cigar-shaped capsule.

Diplacanthopoma squamiceps Lloyd is very similar to this species. It differs in having the head slightly longer, fewer rays in the pectoral, and (if his figure is correct) ventrals bifid, scales larger, and origin of anal much nearer tip of caudal than tip of snout.

There is one other example in the collection 7.8 cm. in length from station 5515 (700 fathoms), off northern Mindanao. It has the top of the head scaled, as in *squamiceps;* the origin of the anal slightly farther back than in the type, but considerably farther forward than in *squamiceps.*

LUCIOBROTULA Smith and Radcliffe, new genus.

Catætyx-like brotulids, having the ventrals bifid, divided nearly to base; pyloric cœca absent; head pike-like; scales small, deciduous, scaling of top of head extending forward to front of eyes; eyes small; fleshy sheath at base of dorsal and anal scaled.

Type of the genus.—*Luciobrotula bartschi,* new species.

Digitized by Google

LUCIOBROTULA BARTSCHI Smith and Radcliffe, new species.

Plate 16, fig. 2.

Dorsal, 85; caudal, 13; anal, 68; ventrals, 2; pectorals, 25.

Head 4.40 (4.73 in total length), long, depressed, pike-like, porous, dorsal contour-line slightly concave; body relatively short, compressed, not markedly attenuated posteriorly, greatest depth 5.90 (6.34 in total length); eye small, dorso-lateral, 7.85 in head, 1.78 in snout, 1.28 in interorbital; snout 4.40, pointed, not projecting beyond mouth, mouth large, oblique, lower jaw included; maxillary 1.96, reaching for more than an eye-diameter beyond vertical from posterior margin of eye, posterior end expanded, 1.5 times as broad as eye, anterior upper margin slipping under expanded suborbital; bands of small villiform teeth on jaws, vomer, and palatines, vomerine patch broadly ∩-shaped; interorbital 6.12, flattened; nostrils small, rather close together; opercle armed with 2 spines as in *Sarcocara*, the lower one rather inconspicuous; preopercle unarmed; pseudobranchiæ present, represented by 2 small filaments; gills 4, a long slit behind the fourth; gill-filaments relatively short; only 3 developed gill-rakers on anterior arch; pyloric cœca absent; scales small, deciduous, covering body, cheeks, opercles, and top of head to front of eyes, apparently about 10 scales from origin of dorsal to and including lateral line, about 33 from anal to lateral line; lateral line indistinct, interrupted in the middle.

Dorsal and anal continuous with the caudal; dorsal posterior in its insertion, its distance from tip of snout 3.23 (3.47 in total length); distance of anal from tip of snout 1.95 (2.09 in total length); ventrals consisting of 2 flattened rays divided nearly to base, inner ray longest 1.83 in head, their bases close together behind tip of humeral symphysis; pectoral 1.90, short, broad, acutely rounded.

Color in alcohol: Body pinkish-buff, dark grayish on belly, becoming blackish in region of vent; opercular region blackish; cheek light chestnut; rest of head with a grayish wash; scaly sheath of the dorsal and anal similar in coloration to the adjacent parts of body; fins margined with blackish, the dark area widening posteriorly; pectorals grayish at base, with a brownish wash distally; ventrals light brown.

Type.—Cat. No. 74151, U.S.N.M., 26 cm. in length, taken with a beam trawl at station 5348 (lat. 10° 57′ 45″ N.; long. 118° 38′ 15″ E.), in Palawan Passage, at a depth of 375 fathoms, on a bottom of coral and sand.

This species is named in honor of Dr. Paul Bartsch, a member of the *Albatross* Philippine expedition and assistant curator in the National Museum.

Digitized by Google

Genus BYTHITES Reinhardt.

The Philippine form which we have assigned to this genus differs from *Sarcocara* in having the body relatively short, the tail not attentuated; head high, thick; cheeks, opercles, and occiput covered with small inconspicuous scales (head said to be naked in type); eyes dorso-lateral; a short, thick, flap-like appendage on each side of the pylorus; scales small, subcircular, persistent; lateral line distinct, interrupted mesially, the 2 parts overlapping the same vertical; tips of clavicles loosely joined, apparently separate below; dorsal 76; anal 52.

BYTHITES LEPIDOGENYS Smith and Radcliffe, new species.

Plate 16, fig. 3.

Dorsal 76; caudal 11; anal 52; ventrals 1; pectorals 20.

Head 3.51 (3.85 in total length), large, thick, greatest breadth nearly equal to its depth, with small, scattered cirri; body short, compressed posteriorly, greatest depth 4.16 (4.57 in total length); eye 6, small, circular, dorso-lateral; snout 3.73, rounded, not markedly depressed; mouth broad, oblique, lower jaw included; maxillary 1.86, extending for about 0.4 an eye diameter beyond vertical from posterior margin of eye, nearly concealed by expanded suborbital, posterior margin truncate, about as wide as eye; narrow bands of villiform teeth on jaws, vomer, and palatines, each arm of patch on vomer slightly incurved; interorbital 4.10, broadly convex; opercle armed with a single sharp spine; preopercle unarmed; pseudo branchiæ consisting of 2 small filaments; gill-filaments short, only 3 developed gill-rakers on first arch; branchiostegals 8; a broad, flap-like appendage on each side of the pylorus; scales persistent; occiput, cheek, and opercle scaled, rest of head naked; 7 or 8 scales in a series from origin of dorsal to and including lateral line, 17 from origin of anal to lateral line; lateral line interrupted mesially, the 2 parts overlapping the same vertical.

Dorsal and anal continuous with the caudal; dorsal posterior in its insertion, its distance from tip of snout 2.82 (3.04 in total length); distance of anal from tip of snout 1.68 (1.84 in total length); basal portion of dorsal and anal with a scaleless, transparent membranous sheath; caudal short, pointed; ventrals 2.05 in head, composed of 2 flattened rays, united throughout their length, their bases close together behind humeral symphysis; tips of clavicles loosely joined, apparently separate at lower end; pectoral 1.71.

Color in alcohol: Broccoli brown; belly with a grayish wash, becoming nearly black in front of vent; vertical fins dusky; paired fins grayish.

Type.—Cat. No. 74152, U.S.N.M., 7.9 cm. in length, taken with a beam trawl at station 5214 (lat. 12° 25′ 18″ N.; long. 123° 37′ 15″

Digitized by Google

E.), east of Masbate Island, at a depth of 218 fathoms, on a bottom of green mud.

The characters of this species agree quite closely with those given for the genus *Bythites*, the main difference appearing to be the presence of scales on cheek, opercle, and top of head posteriorly. These are inconspicuous and might easily be overlooked.

XENOBYTHITES Smith and Radcliffe, new genus.

Body relatively short, covered with small, thin scales. Head high depressed anteriorly, cheeks and opercles covered with small, inconspicuous scales; a few small cilia scattered over naked portions of head; bones of skull firm; snout low; upper jaw very slightly overhanging lower; narrow bands of slightly unequal villiform teeth on jaws and palatines; patch on vomer arched, the teeth mainly in 2 rows; eyes lateral; opercle armed with a slender spine; margin of preopercle armed with 5 or 6 spines, portion between spines incised; lateral line inconspicuous, interrupted in the middle, the two parts overlapping the same vertical. Branchiostegals 8; gill-filaments short; 6 developed gill-rakers on first arch; pseudobranchiæ consisting of 2 small filaments; a short, thick, flap-like appendage on each side of the pylorus. Vertical fins united, dorsal about 85, anal about 72; ventrals absent; tips of clavicles apparently not united; pectorals simple. Species viviparous.

Type of the genus.—Xenobythites armiger, new species.

XENOBYTHITES ARMIGER Smith and Radcliffe, new species.

Plate 16, fig. 4.

Dorsal about 85; caudal 8; anal 72; pectorals 22.

Head 3.23 (3.47 in total length), short, depressed anteriorly, very strongly arched posteriorly, considerably deeper than broad, naked portions covered with small, scattered cilia; suborbital porous; body short, deep, strongly compressed posteriorly, belly decurved; greatest depth 3.64 (3.90 in total length); eye 5.50 in head, 1.32 in snout, 1.9 in interorbital, circular, lateral, but situated close to dorsal surface; snout 4.15, dorsal contour longitudinally very oblique, laterally evenly rounded; mouth broad, oblique, lower jaw slightly included; maxillary 2, extending about 0.5 an eye diameter beyond vertical from posterior margin of eye, the upper margin slipping under suborbital, the posterior end expanded, about as wide as eye; bands of slightly unequal villiform teeth on jaws and palatines; patch on vomer arched, mainly in 2 rows; interorbital 2.90, broad, slightly convex; opercle armed with a single slender spine; preopercle armed with 5 or 6 small, sharp spines, the portion between spines incised; pseudobranchiæ consisting of 2 small filaments; gill-filaments short; 6 developed gill-rakers on first arch; branchiostegals 8; tips of clavicular bones

Digitized by Google

apparently free; a broad flap-like appendage on each side of the pylorus; scales persistent; cheeks and opercles covered with small inconspicuous scales, rest of head naked; lateral line inconspicuous, interrupted in the middle, the two parts overlapping the same vertical.

Dorsal and anal continuous with the caudal; dorsal posterior in its insertion, its distance from tip of snout 2.15 (2.31 in total length); distance of anal from tip of snout 1.92 (2.06 in total length); caudal short, pointed; ventrals absent; pectoral 2 in head.

Color in alcohol: Clay color, becoming grayish ventrally; area in front of vent and median line of belly black; under side of head cream buff; fins translucent; peritoneum very dark seal brown.

Type.—Cat. No. 74153, U.S.N.M., 7.6 cm. in length, taken with a beam trawl at station 5504 (lat. 8° 35′ 30″ N.; long. 124° 36′ 00″ E.), in Macajalar Bay, Mindanao, at a depth of 200 fathoms, on a bottom of green mud.

A second example, 3.2 cm. in length, was taken at station 5624 (288 fathoms), near Makayan Island.

Genus HEPHTHOCARA Alcock.

HEPHTHOCARA CRASSICEPS Smith and Radcliffe, new species.

Plate 17, figs. 1 and 2.

Dorsal about 140; anal about 105; pectorals 19.

Head 4.85 in total length, very large, broad, and deep, its breadth about 0.75 its length, its depth about equal to its length; upper surface of snout nearly horizontal, nearly on a level with upper margin of eye, from this point the contour line rises very abruptly, the posterior part of head being much inflated; ventral contour line rather deeply convex; bones of head thin, smooth, covered with a thin, scaleless, gelatinous integument; body compressed, not as deep as head, tapering to a long slender filament; eye 6.44 in head, 1.78 in snout, 2.33 in interorbital, small, circular, the membrane bones surrounding it projecting rather strongly; snout 3.62, short, blunt, broader than long, depressed; mouth very broad and oblique, lower jaw included, its tip coterminous with incised toothless margin of upper jaw lying between ends of premaxillaries; maxillary 1.87, all except the lower posterior margin concealed by suborbital, reaching about 0.5 an eye-diameter beyond vertical from posterior margin of eye; a narrow band of small, unequal teeth with incurved tips on mandible; a broad band of villiform teeth on premaxillaries; teeth on vomer and palatines in very narrow bands; nostrils very large and conspicuous, the diameter of the aperature of posterior nostril being 0.5 as long as eye; interorbital 2.76, broad, flattened; opercle armed with a rather weak spine; preopercle unarmed; pseudobranchiæ rudimentary; gill-filaments very short; gill-rakers 4+17, 3 near the angle about as long as eye, the others short, little produced; pyloric

Digitized by Google

cœca absent; lateral line indistinguishable; scales small, cycloid, deciduous, about 22 from origin of anal to dorsal.

Dorsal and anal continuous with the caudal; origin of dorsal from tip of snout 4.10 in total length; caudal very long and narrow (broken in the type); origin of anal from tip of snout 2.67; ventrals absent; pectoral 2.07, longer than snout plus eye.

Color in alcohol: Body russet, becoming dusky black on belly; the thin outer skin of head and fins clove brown; inside of gill-chamber and peritoneum dark clove brown.

Type.—Cat. No. 74154, U.S.N.M., about 28 cm. in length, taken with a beam trawl at station 5647 (lat. 5° 34′ 00″ S.; long. 122° 18′ 15″ E.), in Buton Strait, at a depth of 519 fathoms, on a bottom of green mud.

This species appears to be distinct from the poorly described and figured *H. simum* of Alcock.

Family CARAPIDÆ.

The types of *Snyderidia* Gilbert and *Pyramodon* (herein described) appear to have more characters in common with *Carapus* Rafinesque than with the type of *Lycodapus* Gilbert, and in our opinion belong in this family.

PYRAMODON Smith and Radcliffe, new genus.

This genus is distinguished from *Snyderidia* by the presence of ventral filaments; by the position of the vent and the origin of anal, which are farther cephalad under anterior dorsal rays, slightly behind vertical from axil of pectoral; by the shorter and deeper body; and by the larger, more nearly horizontal mouth.

The type of *Echiodon* Thompson is slenderer, more elongate, without ventral filaments, and without fang-like canines on the vomer.

Type of the genus.—Pyramodon ventralis, new species.

PYRAMODON VENTRALIS Smith and Radcliffe, new species.

Plate 17, fig. 3.

Dorsal about 140; anal about 140; caudal 4; ventrals 1; pectorals 26.

Head 6.43 in total length, pointed, compressed, arched, a slight concavity in upper profile above eye, posterior line of occiput midway between middle of eye and origin of dorsal; body deep, compressed, produced into a long slender tail, less attenuated than in *Snyderidia canina;* greatest body depth 6.76 in total length; eye 4.84, large, subcircular; snout equal to eye, low, narrow, laterally convex; mouth large, not as oblique as in *S. canina*, upper jaw overlapping lower except at tip; maxillary 1.70, extending 0.83 of an eye diameter beyond vertical from posterior margin of eye, channel on outer

Digitized by Google

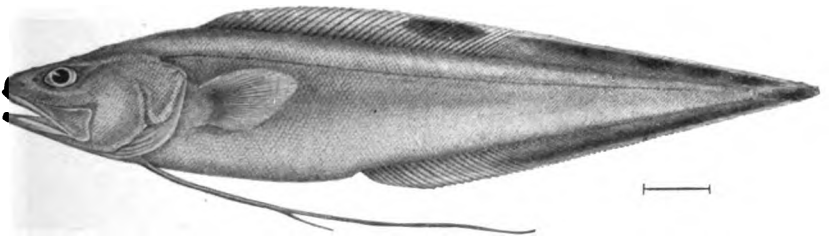
face posteriorly shallower than in *S. canina;* a median row of small canine-like teeth on sides of mandible and a short inner and outer row of smaller teeth anteriorly; a short toothless space in front of lateral series and a pair of long, curved canines one on either side of symphysis at tip of mandible, fitting into a groove behind a pair of similar more widely separated fangs on upper jaw; a rather wide band of small cardiform teeth on sides of premaxillary, the inner row depressible; a long fang on head of vomer, a number of small, conical irregularly arranged teeth behind this; a single series of small conical teeth on palatines, anterior ones largest; fangs on left side of maxillary and mandible double; interorbital low, convex, its breadth equal to diameter of eye; opercle bearing 2 inconspicuous diverging ridges ending in a spine-like tip; margin of preopercle adnate in its upper half, free below, unarmed; pseudobranchiæ represented by 2 small filaments; gill-filaments short, 3 developed gill-rakers on anterior arch next the angle, small spinigerous tubercles along edge below these; gill-membranes separate, free from the isthmus; branchiostegals 7; pyloric cœca 2, one on either side of pylorus; skin thin, scaleless, smooth, lateral line absent; vent anterior, immediately in front of origin of anal, under origin of dorsal farther forward than in *S. canina;* stomach much distended, filled with the remains of a fish.

Dorsal and anal continuous with the caudal; origin of dorsal from tip of snout 5.02 in total length; dorsal rays shorter and weaker than those of the anal; anterior anal rays longest; origin of anal under second dorsal ray; ventrals present, each consisting of a slender filament, one-third the length of head; bases close together behind tip of humeral symphysis; pectorals broad, the median rays longest, nearly 1.33 times length of head. (In our example of *S. canina* the pectoral is also much longer than head; in the type the pectoral is said to be equal to head, but the rays are now broken, and their length can not be determined.)

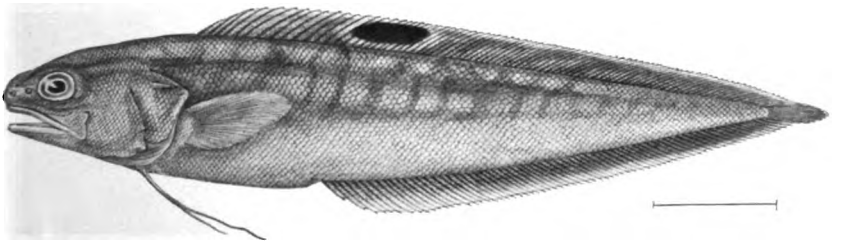
Color in alcohol: Ochraceous-buff, dotted with small pigment spots smaller than in *S. canina;* belly more or less silvery; fins straw color; posterior rays of dorsal, anal, and adjacent part of the tail somewhat darker; peritoneum brownish black.

Type.—Cat. No. 74155, U.S.N.M., 19.6 cm. in length, taken with a beam trawl at station 5629 (lat. 00° 50′ 00″ S.; long. 128° 12′ 00″ E.), near Doworra Island, Dutch East Indies, at a depth of 205 fathoms, on a bottom of coral sand.

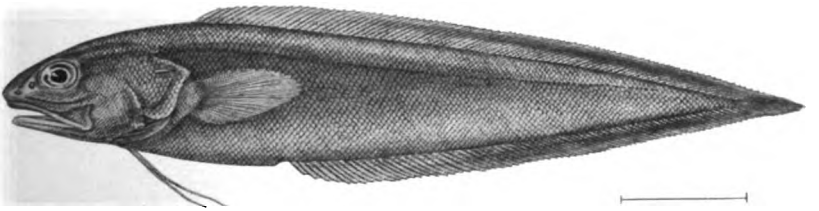
Digitized by Google



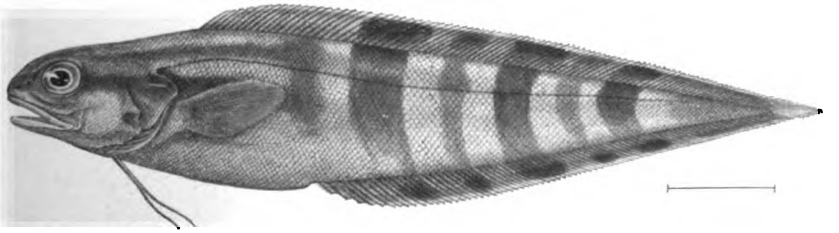
1. NEOBYTHITES LONGIPES. (PAGE 139.) FROM THE TYPE.



2. NEOBYTHITES (WATASEA) UNIMACULATUS. (PAGE 140.) FROM THE TYPE



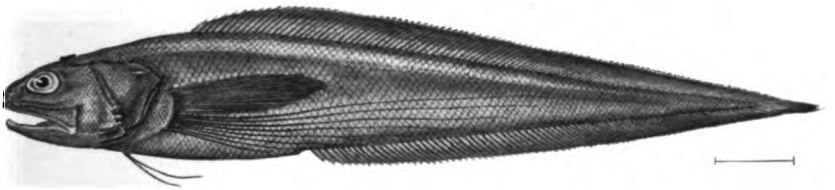
3. NEOBYTHITES (WATASEA) PURUS. (PAGE 141.) FROM THE TYPE.



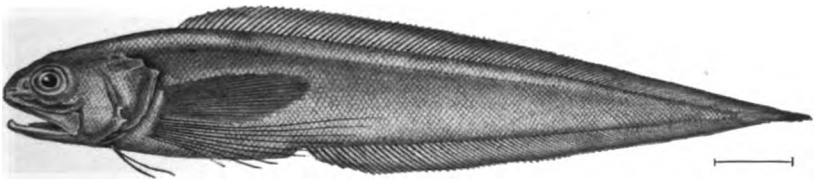
4. NEOBYTHITES (WATASEA) FASCIATUS. (PAGE 142.) FROM THE TYPE.

Digitized by Google

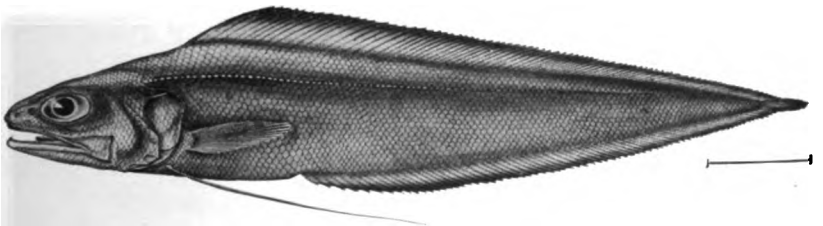
Digitized by Google



1. DICROLENE LONGIMANA. (PAGE 144.) FROM THE TYPE.



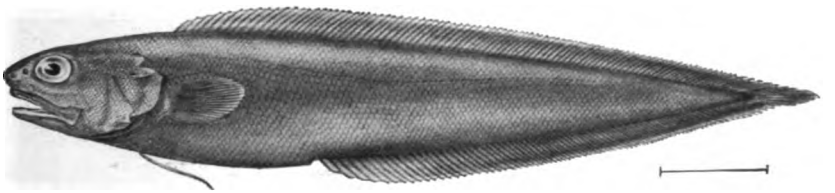
2. DICROLENE TRISTIS. (PAGE 145.) FROM THE TYPE.



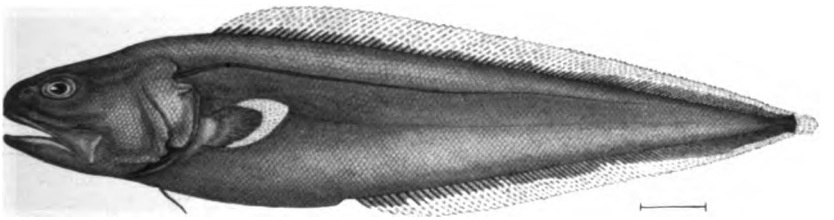
3. HOMOSTOLUS ACER. (PAGE 147.) FROM THE TYPE.

Digitized by Google

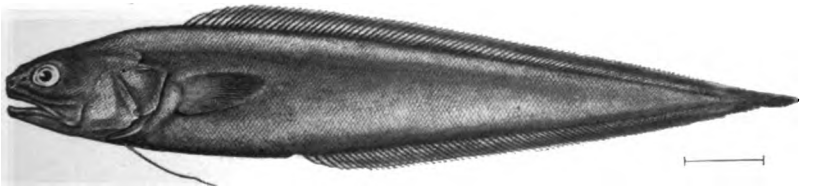
Digitized by Google



1. MONOMITOPUS PALLIDUS. (PAGE 148.) FROM THE TYPE.



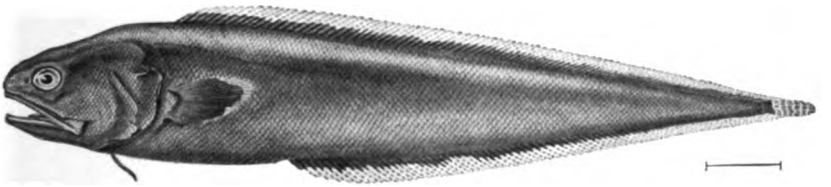
2. MONOMITOPUS LONGICEPS. (PAGE 149.) FROM THE TYPE.



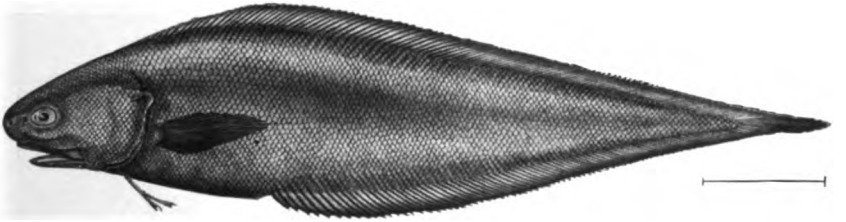
3. MONOMITOPUS MICROLEPIS. (PAGE 150.) FROM THE TYPE.

Digitized by Google

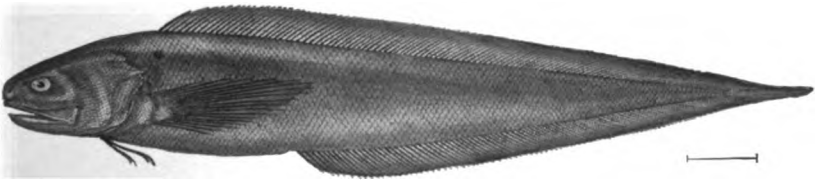
Digitized by Google



1. MONOMEROPUS GARMANI. (PAGE 151.) FROM THE TYPE.



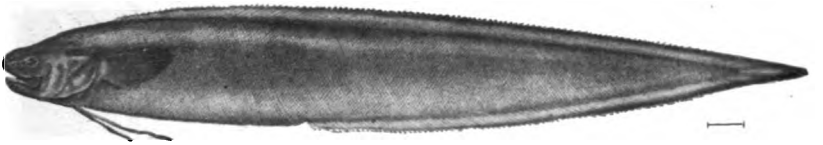
2. BARATHRODEMUS NASUTUS. (PAGE 152.) FROM THE TYPE.



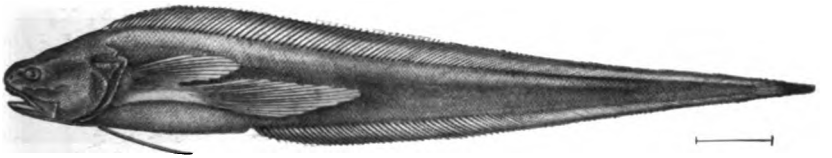
3. BASSOGIGAS ÆQUATORIS. (PAGE 153.) FROM THE TYPE.

Digitized by Google

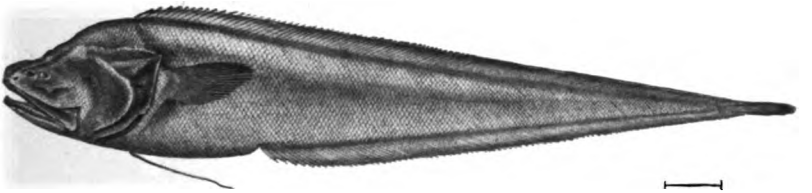
Digitized by Google



1. ENCHELYBROTULA PAUCIDENS. (PAGE 154.) FROM THE TYPE



2. ERETM'CHTHYS REMIFER. (PAGE 155.) FROM THE TYPE.

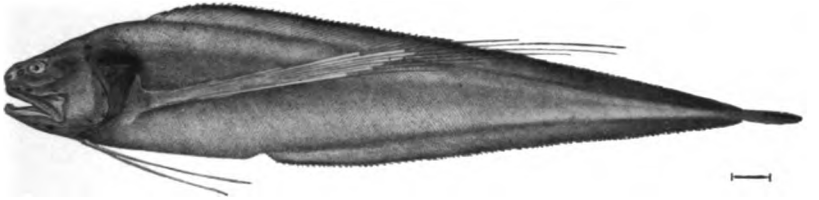


3. BASSOZETUS ROBUSTUS. (PAGE 156.) FROM THE TYPE.

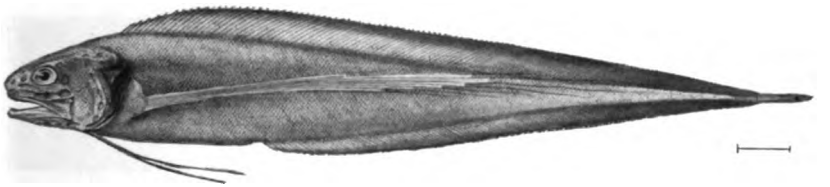
4. BASSOZETUS ELONGATUS. (PAGE 157.) FROM THE TYPE.

Digitized by Google

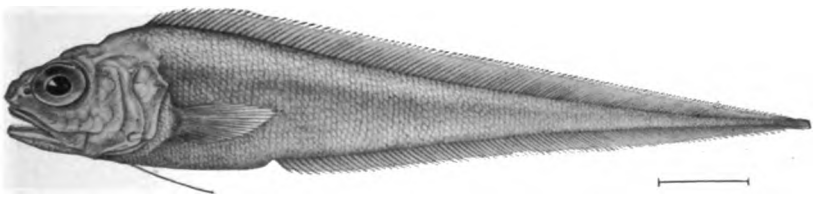
Digitized by Google



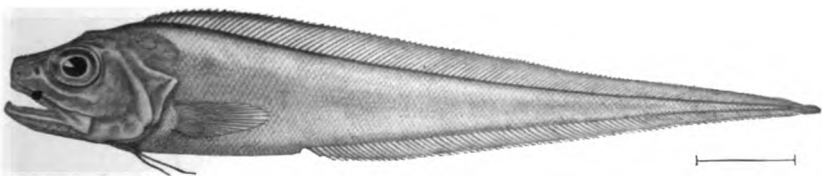
1. MASTIGOPTERUS IMPERATOR. (PAGE 159.) FROM THE TYPE.



2. MASTIGOPTERUS PRÆTOR. (PAGE 160.) FROM THE TYPE.



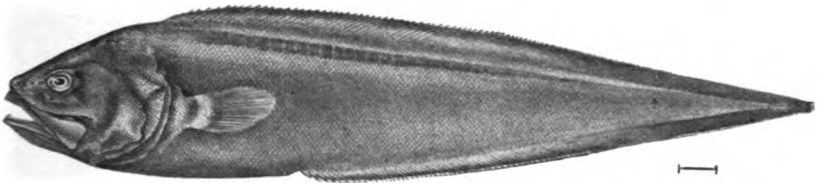
3. GLYPTOPHIDIUM LUCIDUM. (PAGE 161.) FROM THE TYPE.



4. GLYPTOPHIDIUM OCEANIUM. (PAGE 162.) FROM THE TYPE.

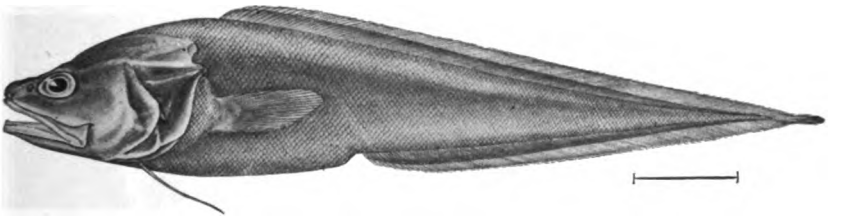
Digitized by Google

Digitized by Google

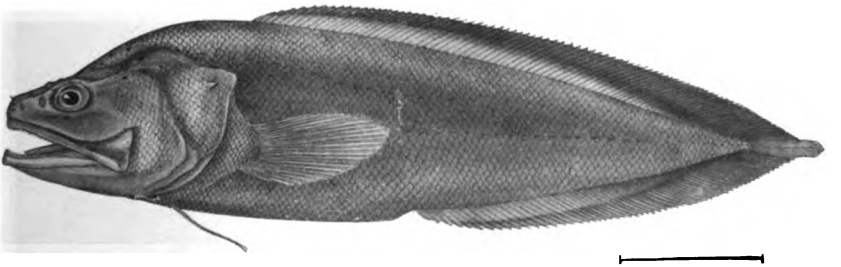


1. LAMPROGRAMMUS MACROPTERUS. (PAGE 163.) FROM THE TYPE.

2. HYPOPLEURON CANINUM. (PAGE 165.) FROM THE TYPE.



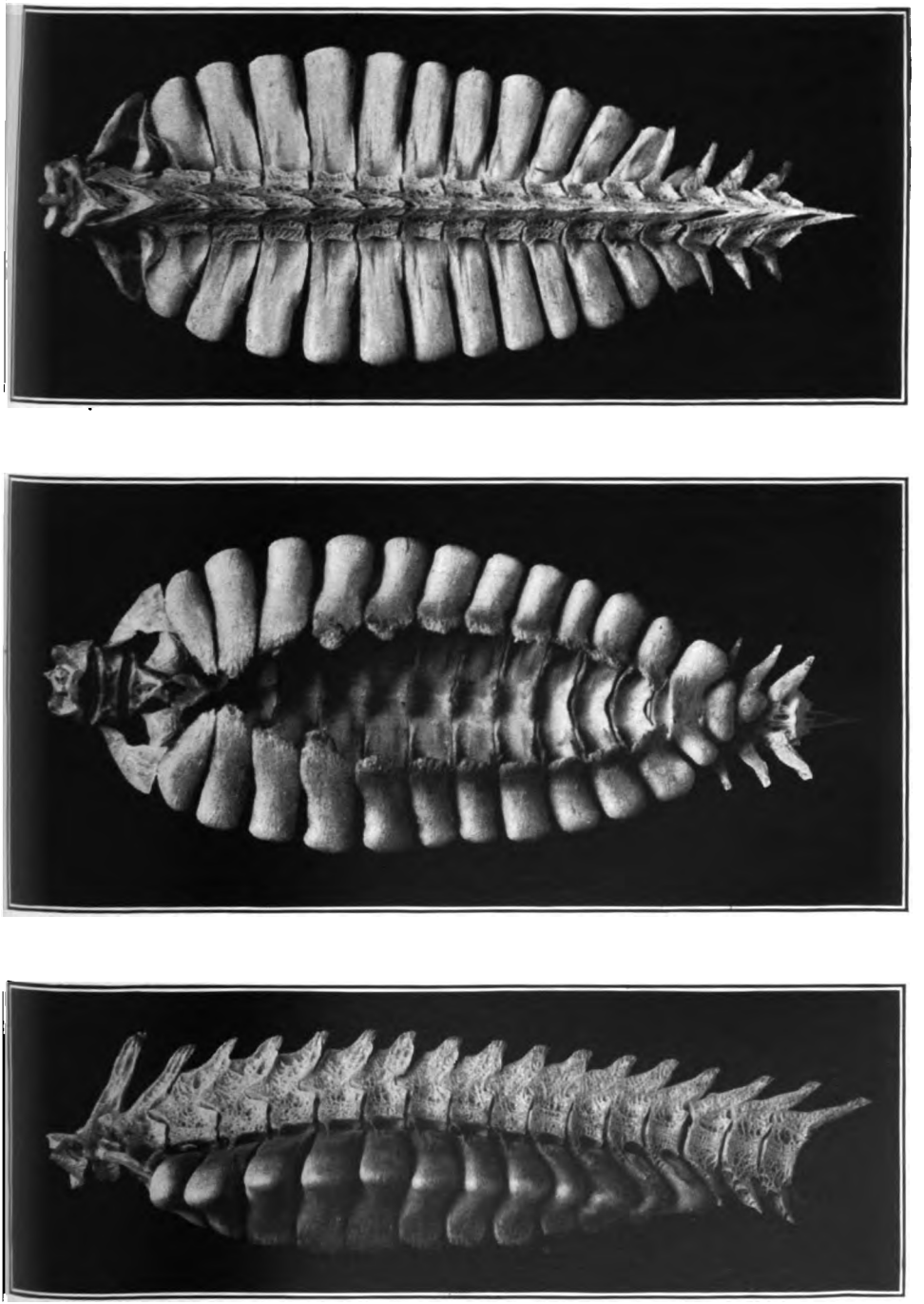
3. DIPLACANTHOPOMA (SARCOCARA) BRUNNEA. (PAGE 167.) FROM THE TYPE.



4. GRAMMONUS ROBUSTUS. (PAGE 168.) FROM THE TYPE.

Digitized by Google

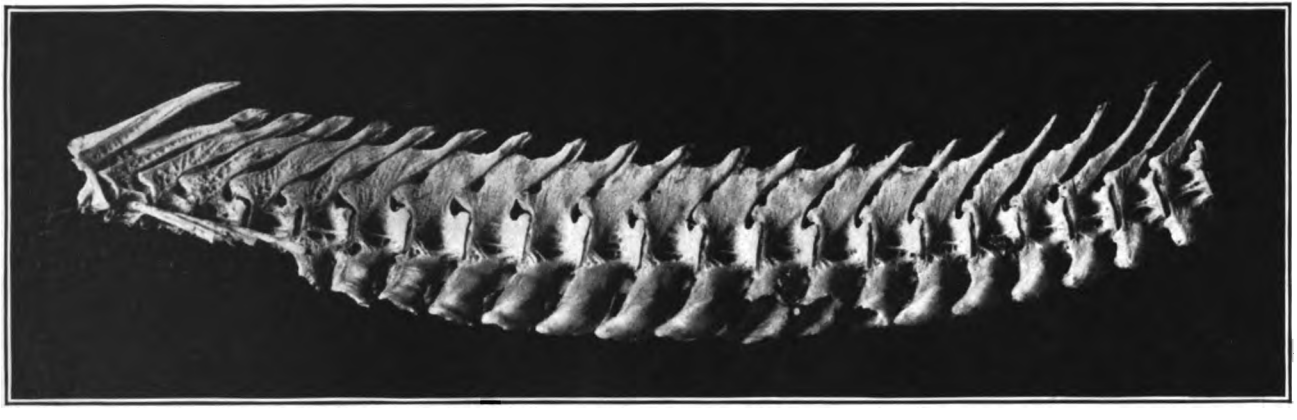
Digitized by Google



ABDOMINAL VERTEBRÆ OF HYPOPLEURON CANINUM. DORSAL, VENTRAL, AND LATERAL VIEWS. NATURAL SIZE. (PAGE 165.)

Digitized by Google

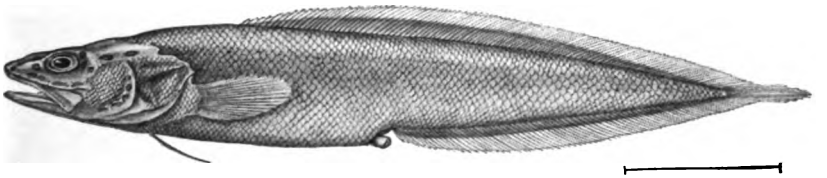
Digitized by Google



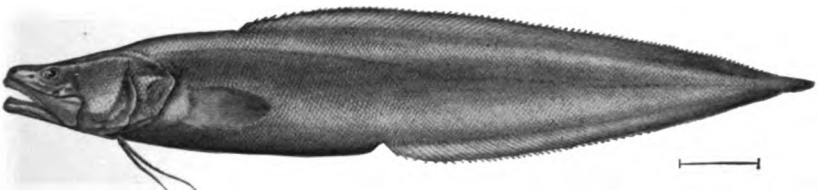
ABDOMINAL VERTEBRÆ OF MERLUCCIUS PRODUCTUS. VENTRAL AND LATERAL VIEWS. NATURAL SIZE. (PAGE 165.)

Digitized by Google

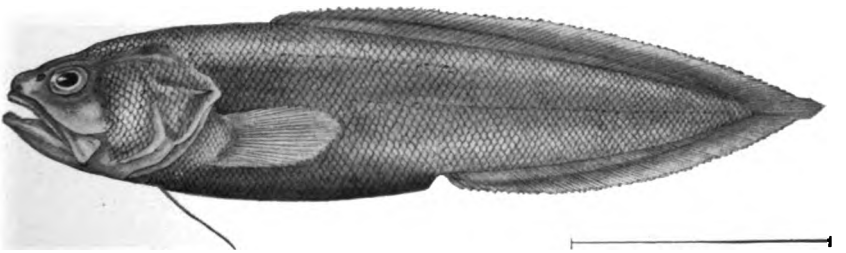
Digitized by Google



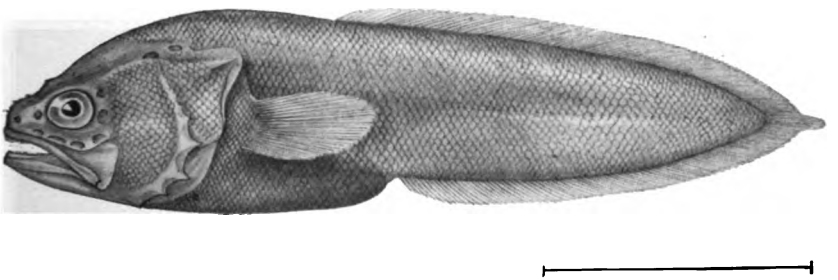
1. CATÆTYX PLATYCEPHALUS. (PAGE 169.) FROM THE TYPE.



2. LUCIOBROTULA BARTSCHI. (PAGE 171.) FROM THE TYPE.



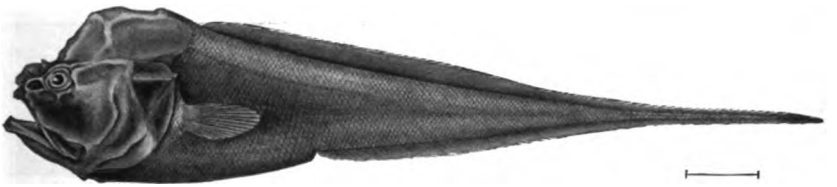
3. BYTHITES LEPIDOGENYS. (PAGE 172.) FROM THE TYPE.



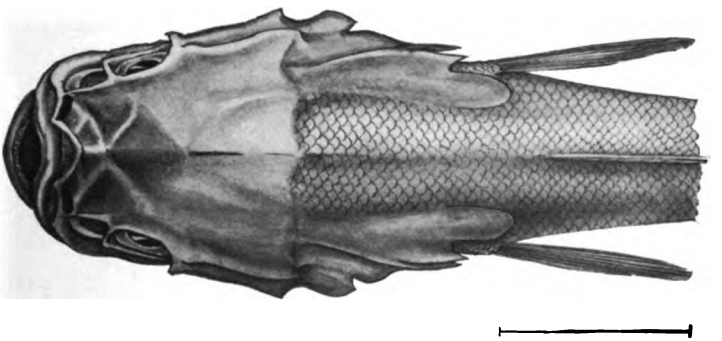
4. XENOBYTHITES ARMIGER. (PAGE 173.) FROM THE TYPE

Digitized by Google

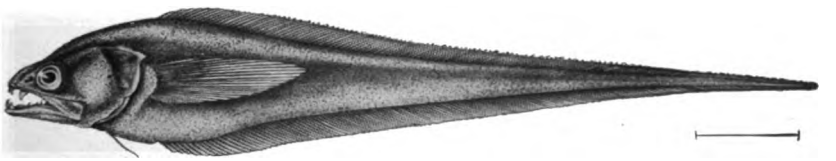
Digitized by Google



1. HEPHTHOCARA CRASSICEPS. (PAGE 174.) FROM THE TYPE.



2. HEPHTHOCARA CRASSICEPS. (PAGE 174.) DORSAL VIEW.



3. PYRAMODON VENTRALIS. (PAGE 175.) FROM THE TYPE.

Digitized by Google

Digitized by Google

RESULTS OF THE YALE PERUVIAN EXPEDITION OF 1911. ORTHOPTERA (ACRIDIIDÆ—SHORT-HORNED LOCUSTS).

By LAWRENCE BRUNER,
Of the University of Nebraska, Lincoln, Nebraska.

The insects upon which the present report is based are part of a collection made in Peru, South America, by the Yale expedition of 1911. While not extensive, this collection of locusts is interesting on account of the large percentage of new forms that are contained in it. Only 19 species and subspecies are represented by the 92 specimens at hand. Of these 7 are apparently new, and among these are 2 apparently new genera.

Family PROSCOPIDÆ.

ANCHOTATUS PERUVIANUS Brunner.

A single specimen was taken 7,000 feet above sea level on August 8, at Tincochaca.

CEPHALOCOEMA VITTATA, new species.

Similar in form to *Cephalocoema costulata* Burmeister, but very distinct from that species in its much smaller size and smoother body. In the synoptic table of species by me published in the thirtieth volume of the Proceedings of the United States National Museum this insect runs to section *A* under *bb*.

Head a little longer than the pronotum, the rostrum of the vertex slender, quadrangular, a trifle exceeding the rest of the head in length, its sides nearly parallel, in the male gently bent downwards apically, in the female straight; eyes not prominent; antennæ scarcely one-half (male) or a trifle more than one-half (female) the length of the rostrum. Pronotum a little narrowed in advance of the middle, the median carina rather strong and bordered on either side by a well-defined longitudinal sulcus that extends also across the meso- and meta-thorax as well as most of the abdominal segments. There are two small but fairly conspicuous wart-like raised spots on the disk

Digitized by Google

of the prothorax just back of its middle, and the anterior margin is very gently expanded and rounded. Hind femora slender, short, the carinæ not conspicuous; hind tibiæ also slender, 8 or 9 spined on both edges. Supra-anal plate of female elongate triangular, its apex reaching one-third the length of the upper valves of the ovipositor; last ventral segment of male abdomen lanceolate, tricarinate, about as long as the rostrum of the vertex, its apex deeply emarginate.

General color pale brunneo-testaceous; in the female longitudinally trivittate with dull olive above, in the male uniformly olivaceous above and testaceous beneath.

Length of body, male, 45 mm., female, 62 mm.; of head, male, 9 mm., female, 11 mm.; of rostrum, male, 5 mm., female, 6 mm.; of pronotum, male, 7 mm., female, 9.5 mm.; of hind femora, male, 15 mm., female, 19 mm.

One male, three females, two nymphs, Cuzco, July 6–12, 11,500 feet altitude; one nymph, Ollantartambo, July 21, 9,000 feet altitude.

Type.—Female, July 6. Cat. No. 15039, U.S.N.M.

Family TRYXALIDÆ.

ORPHULELLA PUNCTATA De Geer.

Several specimens from Santa Anna, at an elevation of 3,000 feet and a single one from Huadquina, the latter at 5,000 feet above sea level.

These insects are somewhat variable, but run to *punctata* by the various synoptic keys.

ORPHULELLA INTRICATA Stål?

Other specimens of an *Orphulella* coming from San Miguel and Paltaybamba fall nearer to Stål's *intricata* which is not distantly removed from *punctata*. The altitude of the latter locality is given as 5,000 and the former as 6,000 feet.

MELOSCIRTUS MONTANUS, new species.

Similar to, but much larger and more robust than, *Meloscirtus australis* Bruner from Paraguay. Possibly quite variable in color, but without fuscous bands or maculation on the hind femora.

Head moderately large, as wide as the front edge of the pronotum. Eyes a little longer than the anterior edge of the cheeks immediately below them, separated above by a space one-half wider than the frontal costa between the antennæ, the fastigium noticeably but shallowly sulcate, its antero-lateral carinæ meeting in front in a right angle, the lateral foveolæ very plainly visible from above, a little more than twice as long as broad, quadrangular. Frontal costa prominent, widening almost evenly downwards and reaching the clypeus, not at all or scarcely sulcate, coarsely punctulate at sides above the

Digitized by Google

ocellus. Antennæ slightly flattened, only reaching the last transverse sulcus of the pronotum. The latter a little constricted laterally in the middle, the lateral carinæ prominent, continuous strongly arcuate, approaching most closely at the anterior transverse sulcus; median carina prominent throughout, cut at middle by the last sulcus; anterior margin straight, the posterior margin broadly angulate; lateral lobes more or less longitudinally rugose, the hind lobe coarsely punctulate. Tegmina abbreviated, lateral, acuminate, their costal margin roundly expanding on the basal half. Hind femora moderately robust, as long as the abdomen; the tibiæ 10-spined externally, the inner apical spurs much longer than the outer ones, unequal in size.

General color varying from pale green to dull wood brown. Marked on the sides of head, pronotum and tegmina much as is *Meloscirtus australis*. Hind femora without definite fuscous markings across the upper edge and outer disk. The inner disk somewhat varied with piceous, and the upper portion of outer disk evenly embrowned. Tegmina faintly conspersed with fuscous and provided with a lanceolate subcostal pale stripe that extends fully three-fifths the length of the wing. Lower side of body pallid; the hind tibiæ vinaceous red.

Length of body, female, 21–23 mm.; of pronotum, 4.35 mm.; of tegmina, 7 mm.; of hind femora, 13 mm.

Habitat.—There are four female specimens of this locust at hand. They were taken in July at Cuzco, Peru, 11,500 feet above sea level, where the insect fauna undoubtedly is strongly boreal in its make-up.

Type.—Female. Cat. No. 15040, U.S.N.M.

Family LOCUSTIDÆ (OEDIPODINÆ).

TRIMEROTROPIS OCHRACEIPENNIS Blanchard.

The only Oedipodine locust represented in the collection studied is referred to Blanchard's *ochraceipennis*. The nine specimens at hand were taken at Cuzco, where the elevation is recorded as 11,500 feet. Both sexes are represented. They show but little variation in markings and size.

Family OMMEXICHIDÆ.

OMMEXECHA BRUNNERI Bolivar.

Four specimens belonging to this genus are referred to Bolivar's *brunneri*. They were taken, one male at Huadquina, two females at San Miguel, and the fourth at Torontoy, the latter having an elevation of 7,000 feet. All these specimens were taken during the latter part of July.

CUMAINOCLOIDUS, new genus.

The present genus is based on an apterous or subapterous locust with a slightly compressed and rather strongly rugose body, having

Digitized by Google

the hind margin of the pronotum plainly reflexed and strongly undulate throughout. The hind tibiæ are spined at the apex externally and the prosternum has its anterior margin developed into a fairly strong spine.

While very distinct from all other known forms this insect seems to show affinities with the Ommexichidæ rather than with the Acridiidæ or Cyrtacanthacridæ, as we may be obliged to write it. Its type is the following-described species:

CUMAINOCLOIDUS CORDILLERÆ, new species.

Body robust about the thorax and the base of the abdomen, compressed, the surface of the head, pronotum, meso- and meta-thorax and the basal segment of the abdomen irregularly and strongly rugose. Head moderately large, higher than wide, its sides nearly parallel, set into the thorax almost to the eyes. Latter small, not prominent, elliptical, separated above by a space equal to their shortest diameter, the front portion of the occiput irregularly rugose, the vertex but little depressed, bounded by strong but sinuose carinæ that converge suddenly in front and unite with the lateral walls of the frontal costa, the sulcation irregularly studded with rugosities; frontal costa moderately prominent, narrow above, evenly and gently expanding below, continuous to the clypeus, profoundly sulcate and also studded below the ocellus with a few rugosities; lateral or facial carinæ somewhat divergent below, somewhat irregular or crenulate; the front rather profusely rugulose, as are also the genæ, the anterior margin of the latter nearly or quite one-half longer than the eyes. Antennæ slender, not quite as long as the head and pronotum combined, most of the joints a little depressed, 16 or 17 in number. Pronotum tectiform, the median carina prominent and notched by all three transverse sulci, giving to it a lobed appearance when viewed laterally, the posterior sulcus alone continuous; lateral carinæ wanting; anterior margin faintly undulate and slightly angulately advanced upon the occiput, but with the apex gently notched; hind margin somewhat thickened or reflexed, lobately undulate throughout with about seven such lobes on each side of the middle. Surface rugose. Tegmina visible only as very minute lateral pads, the apex of which barely show beyond the hind margin of the pronotum. Hind femora moderately robust, evenly tapering toward the apex, the outer and upper carinæ rather distantly and minutely spined or toothed; hind tibiæ robust, 11-spined on both margins including the apical ones, the spines heavy and equal on the two margins, extending from near the base. Prosternum with its anterior margin at center raised so as to form a fairly acute triangular spine. Mesosternal lobes rounded internally, the space between them fully twice as wide as long and wider than the lobes themselves;

Digitized by Google

metasternal lobes also quite widely separated. Valves of the ovipositor short but strong, the apical hooks short. Auditory apparatus minute or missing.

General color variable, possibly depending upon the kind of soil upon which the insect is found, in the type-specimen brunneotestaceous, with a ferruginous tinge on its pronotum and the outer disk of the hind femora. The latter with a basal, median, and subapical fuscous patch on the upper margin; the genicular lunules piceous, as are also the carinal teeth; lower sulcus bright carmine; hind tibiæ pale cinereous varied with fuscous flecks and blotches. The second specimen is quite uniformly cinereo-fuscous, showing a tinge of ferruginous only on the lower part of the thorax about the base of its anterior and middle legs. The antennæ in both specimens are ashy gray apically.

Length of body, female 25 mm.; of pronotum, 5.75 mm.; greatest width of latter, 6.5 mm.; length of hind femora, 13 mm.; of antennæ, 6.5 mm.

Two females, Ollantaytambo, Peru, July 21, at an elevation of approximately 9,000 feet above sea level.

Judging from the general appearance of the two specimens before me, this insect must be confined in its distribution to more or less arid localities.

Type.—Cat. No. 15041, U.S.N.M.

Family CYRTACANTHACRIDÆ (ACRIDIIDÆ).

DIEDRONOTUS ANGULATUS Stål.

Only a single specimen of this extensive South American genus is at hand. It was taken on the Pampaconas River during the month of August. While the present insect is rather longer winged than usual, it is referred, nevertheless, to Stål's *angulatus*.

PRIONOLOPHA SERRATA Linnæus.

Two females of this magnificent locust are at hand from Huadquina. They are typical specimens.

URUBAMBA, new genus.[1]

Related to *Jivarus* Giglio-Tos and *Platyphyma* Fieber. A genus of inconspicuous South American locusts of small size, the species of which are either apterous or subapterous, and have apical spines on both margins of the hind tibiæ and a much shorter hind lobe of the pronotum than the anterior one. The posterior margin of the former is broadly emarginate. So far as known the representatives of this genus are confined in their distribution to the Andean regions of

[1] Urubamba is a geographical name in the region which is the habitat of these small locusts. It has been chosen on account of its euphony.

Digitized by Google

Peru and possibly of Bolivia and Ecuador also. *Platyphyma* is found only in the Old World, and hence need not be compared with *Urubamba*, which latter genus may be separated from *Jivarus* by the following table:

Key for separating the South American Platyphymata.

Body subfusiform; front strongly oblique. Antennæ 16-jointed. Last ventral segment of male abdomen conical, somewhat acute; the cerci compressed and with the apex spatulate, truncate. Hind tibiæ 8-spined on both margins. *Jivarus* Giglio-Tos.

Body robust anteriorly, but tapering caudad. Front normal, only perceptibly oblique. Antennæ 18-jointed. Last ventral segment short, the apex rounded; the cerci long and slender, the apex pointed. Hind tibiæ 9-spined on both margins ..... *Urubamba*, new genus.

Two distinct species of the genus are at hand, and both seem to be undescribed. They may be separated by the characters given in the subjoined synoptic key.

Body more slender, entirely apterous; the pronotum very strongly rugulose; the lateral carinæ not prominent and much interrupted; the transverse sulci not especially profound. Prosternal spine, coarse, short, and blunt. Hind femora, at least in the female, provided with fuscous bands, the genicular area not infuscated. Insect, especially the legs, strongly hirsute..... *aptera*, new species.

Body more robust; the pronotum rugose only at the sides of the anterior lobe, the hind lobe coarsely and closely pitted or punctulate; lateral carinæ prominent, but little interrupted; transverse sulci profound. Prosternal spine robust and transverse at its base, acuminate. Hind femora without fuscous bands, the genicular portion prominently infuscated. Insect scarcely hirsute, even on the legs ..... *inconspicua*, new species.

The species *aptera*, which is represented by both sexes, may be considered as the type of the genus.

URUBAMBA APTERA, new species.

General color pallid, more or less varied on the head back of the eyes, on the upper half of the sides of the pronotum, and on the sides of the basal abdominal segments with brown or piceous. Possibly varying from testaceous to olivaceous in life according to habitat and age. Hind femora in the female with traces of fuscous bands above and on the outer disk. Lower sulcus reddish purple; hind tibiæ also likewise tinged.

Body rather profusely hirsute throughout; especially is this true with reference to the legs and the hind tibiæ and tarsi in particular, which are clothed with a long pale pile. Head of moderate size, as wide above as below, the eyes rather prominent, rounded behind, narrowest above, the anterior margin straight, separated at the vertex above by a space a little less than the greatest width of the frontal costa above the ocellus; the fastigium of the vertex pro-

Digitized by Google

foundly sulcate and angulately separated from the shallow sulcation of the frontal costa; latter fairly prominent and gently constricted at its sides just below the ocellus, reaching the clypeus; the lateral or facial carinæ divergent below, prominent. Antennæ filiform, in the female not quite as long as, in the male a little longer than, the combined length of the head and the pronotum. Pronotum short, but little (female) or not at all (male) expanded posteriorly, the disk gently tectate, the median carina fairly prominent in front and behind, but obliterated at middle; lateral carinæ interrupted and inconspicuous; anterior margin broadly rounded and gently advanced upon the occiput; hind margin very widely and angulately emarginate. Hind femora slender, reaching (female) or slightly surpassing (male) the apex of the abdomen; the hind tibiæ 9-spined on both margins. Apical portion of male abdomen gently clavate, a slight constriction at the base of the last segment giving this portion a bilobed appearance. Supra-anal plate moderately large, the basal width a little greater than the median length, sides gently approaching apically, near the apex squarely docked but with a small central triangular apical projection; basal half with a triangular sulcation bordered by moderately prominent carinæ; marginal apophyses of preceding segment prominent, triangular and widely separated; male cerci about as long as the supra-anal plate, the basal three-fifths heavy, directed gently to the rear, apical two-fifths slenderer, directed upward, acuminate. Mesosternal lobes separated by a space equal in width to the lobes themselves. Prosternal spine robust, short and very blunt.

Length of body, male, 11 mm., female, 16 mm.; of pronotum, male, 2.5 mm., female, 3 mm.; of hind femora, male, 7 mm., female, 8.5 mm.

Habitat.—The female type comes from San Miguel, Peru, where it was collected September 1, at an elevation of 5,000 feet above sea level; the allotype was taken on August 9, at Tincochaca, at 7,000 feet elevation. Other specimens, immature males and females, are at hand from the last-named locality.

Type and allotype.—Cat. No. 15042, U.S.N.M.

URUBAMBA INCONSPICUA, new species.

A little larger and more robust than the preceding and provided with coarsely punctulate, small, lateral, spatulate tegmina that reach the apex of the first abdominal segment. This insect has a smoother pronotum than *U. aptera* and also has strong lateral carinæ on the pronotum. Its hind femora are much more robust and lack the fuscous bands that characterize the species with which compared, but these members have their genicular area strongly infuscated instead.

Digitized by Google

The specimens of this insect so far as represented in the material before me appear to have been preserved in spirits which have left left them rather uniformly dark vinaceous in color. In life they were possibly olivaceous, with the tegmina flavous and the tibiæ tinged with red. No indications remain of a possible paler lower border on the lateral lobes of the pronotum which are strongly so marked in the species *aptera*.

Length of body, female, 17 mm.; of pronotum, 3.5 mm.; of hind femora, 10 mm.

Habitat.—Three specimens, females, are at hand from Pampaconas River, Peru. They were taken during August.

Type—Cat. No. 15043, U.S.N.M.

PROCTOLABUS BULLATUS Rehn.

There is a male specimen of *Proctolabus* contained in the material taken at Paltaybamba on August 27. Although collected in spirits it still shows the characteristic color patterns. Its antennæ are long and slender, being distinctly longer than the slender hind femora. The latter are olive green with an infuscated genicular area, and the hind tibiæ are reddish with 6 to 8 spines in the outer row. The cerci are a trifle heavier at the point where they bend upward than shown in Rehn's figure.[1]

It is barely possible that the insect described by the present writer under the name of *Poecilocloeus ornatus*[2] is the other sex of this species. The pallid apical joints of the antennæ of that insect would seem, however, sufficient ground to preclude such a surmise, as would also the difference in the arrangement of the thoracic orange markings.

PARALEUAS MINOR Bruner.

On August 6, 1911, a single male specimen of this small locust was secured. It bears the locality label "Paltaybamba" and also 5,000 feet.

DICHROPLUS PERUVIANUS AURIVENTRIS, new variety.

Specimens of a *Dichroplus* are at hand from several localities in the Peruvian Andes that come quite close to *D. peruvianus*, but which are sufficiently distinct in several respects to constitute a separate or distinct variety. Only one of these is in color, the others having been immersed in spirits for longer or shorter periods. The male under consideration has the venter and anal segments of the abdomen brightly tinged with orange, and the sexual characters are simpler than in typical *peruvianus*. The cerci are slenderer and not spatulate at the apex as there, but slightly flattened, acuminate, and bent inwards instead of gently sulcate externally and directed upwards.

[1] Proc. U. S. Nat. Mus., vol. 25, p. 397, fig. 3.

[2] Tire des Horæ Societatis Entomologicae Rossicae, vol. 29, p. 474, Dec., 1910.

Digitized by Google

The last ventral segment of the abdomen in the variety is shorter than in the typical form.

Length of body, male, 14.5 mm., female, 22 mm.; of pronotum, male, 3.9 mm., female, 5.15 mm.; of tegima, male, 4 mm., female, 6 mm.; of hind femora, male, 10 mm., female, 12 mm.

Habitat.—Huadquina, in July, at an elevation of 5,000 feet, also at Tincochaca, 7,000 feet, during August.

Type.—Male from Huadquina. Cat. No. 15044, U.S.N.M.

Specimens of the species coming from an elevation of about 4,000 feet are in the writer's collection. These latter are typical as to size, but some have fully developed wings that extend beyond the apex of the abdomen and tips of the hind femora in the male.

DICHROPLUS PUNCTULATUS Thunberg.

Two males, two females, Huadquina, July, 5,000 feet altitude; one male, Paltaybamba, August 21, 5,000 feet altitude; one female, Santa Ana, August 3, 3,000 feet altitude.

DICHROPLUS, species.

The collection also contains two mutilated females of a *Dichroplus* that were collected on the Pampaconas River during the month of August. These may belong to *D. peruvianus* also, in which case the species under consideration shows a still wider variation than is usual in the majority of species forming the genus. One feature of these last specimens is the coarseness and paucity of the veins of the elytra.

PARADICHROPLUS ANDEANUS, new species.

A medium sized, variable insect with distinctly fuscous banded hind femora and red-tinted tibiæ. Pronotum expanding strongly posteriorly; the dorsum of the abdomen linearly longitudinally pallid at middle and with a row of fuscous dots on each side near the middle of each segment. Antennæ rather robust, short, and gently flattened. Inner face and lower sulcus of the hind femora bright reddish orange in color. Possibly somewhat related to *P. bilobus* Giglio-Tos, which insect has not been examined by the writer.

Surface of the body rather smooth and appearing polished or glabrous. Head of moderate size, a little wider than (male) or not quite as wide (female) as the anterior edge of the pronotum; vertex a little narrower than the prominent frontal costa at the ocellus, its bounding walls prominent, the sulcus fairly profound; frontal costa provided with several coarse punctures above, most noticeably sulcate in the vicinity of the ocellus, continued to the base of the clypeus. Eyes large and fairly prominent in the male, not much longer than wide, their anterior edge but little arcuate, in the female less prominent and with the anterior margin straight; cheeks below the eyes in the

Digitized by Google

female about four-fifths, in the male scarcely more than one-half, the length of the greater diameter of the eyes. Antennæ short, comparatively heavy, their joints somewhat depressed so as to give to these members a flattened appearance. Pronotum evenly widening posteriorly, its surface only gently longitudinally rugose and sparsely punctured on the hind lobe; the median carina visible throughout but most prominent on the posterior lobe and near the front edge of the anterior lobe; lateral carinæ present on the hind lobe of both sexes and to a limited extent also on the anterior one; front margin straight, the hind margin truncate with the middle gently emarginate. Tegmina lateral, nearly twice (female) or a trifle more than twice as long as broad (male), their apex somewhat acuminate, their upper edges distant, but little if any surpassing the hind margin of the first abdominal segment. Abdomen evenly tapering caudal in the female, gently clavate in the male, the dorsum prominently carinated; last ventral segment of male elongate, its apex scarcely notched; supra-anal plate roundly triangulate with raised lateral margins and a heavy raised longitudinal ridge extending from the base to its apex and narrowly sulcate throughout, midway between the base and middle on each side of the plate is an inwardly directed short spur or tooth of the lateral carina; cerci heavy at base but rapidly narrowing toward the middle, curved gently upward and strongly inward, so that their apices almost meet just beyond the apex of the supra-anal plate; marginal apophyses of the preceding segment small and slender, projecting into the basal portion of the plate's median sulcus. Valves of the ovipositor well developed, strong, the apices gently curved. Prosternal spine coarse, pyramidal, transverse at base, the apex blunt. Hind femora normal, in the males a little surpassing, in the females not quite reaching the apex of the abdomen. Hind tibiæ 9-spined externally; anterior and middle femora gently arcuate, a little (female) or decidedly (male) enlarged or inflated. Interspace between the mesosternal lobes as wide as long (male) or noticeably wider than long (female).

General color varying from dark apple-green to a pale brownish-olive, more or less varied with ferruginous and fuscous. In the darker specimens there is a well-defined post-ocular band that is continued across the upper half of the sides of the pronotum, also a ferruginous triangle that continues backward across the disk of the pronotum bordered laterally by a pallid line above the carinæ. The tegmina of all color phases are ferruginous to dull brown; the dorsal carina of the abdomen is pallid, with an approximate fuscous dot on either side near the middle of the segments; the latter are largely piceous laterally, and especially so on those nearest the base. Below the insect varies from bright yellow to pale testaceous; the hind femora are obliquely banded with pallid and fuscous externally, while

Digitized by Google

below and internally they are largely bright reddish orange. The tibiæ vary from pink to deep purplish red.

Length of body, male, 16 mm., female 21 mm.; of pronotum, male, 3.3 mm., female 4 mm.; of tegmina, male and female, 3.5 mm.; of hind femora, male 9 mm., female 11 mm.; of antennæ male and female, 4–5 mm.

Habitat.—Cuzco, Peru, at an elevation of 11,500 feet, and at Urubamba, Peru, 9,500 feet above sea level.

Type.—A male, Cuzco, July 10. Cat. No. 15045, U.S.N.M.

OSMILIA CŒLESTIS Burmeister,

A single *Osmilia* coming from the Pampaconas River is referred to *coelestis* Burmeister, which seems to be distinct from the *violacea* of Thunberg.

Digitized by Google

Digitized by Google

CRUSTACEAN PARASITES OF WEST INDIAN FISHES AND LAND CRABS, WITH DESCRIPTIONS OF NEW GENERA AND SPECIES.

By CHARLES BRANCH WILSON,
Department of Biology, State Normal School, Westfield, Massachusetts.

INTRODUCTORY.

During the summer of 1910 the author enjoyed the privilege of spending three months at the biological laboratory of Johns Hopkins University at Montego Bay, Jamaica.

As a part of the work there accomplished about 100 species of fish, including many hundreds of specimens, were examined for parasitic copepods, isopods, and other parasites that might be of peculiar interest.

Many of the larger crustacea, and in particular the land crabs, were also examined for the same purpose, and several peculiar and unexpected parasites were found upon their gills.

And finally different kinds of ascidians, of which many species live upon the mangrove roots around the Bogue Islands about a mile to the west of the town, and upon the ocean bottom in that vicinity, were carefully examined in order to obtain the various copepods, isopods, and amphipods, which are commensals or semiparasites within them.

The present paper gives the results of these examinations and is chiefly concerned with the copepods although one new species of ostracod is described. For the opportunity of prosecuting this study and for the excellent laboratory privileges which were furnished sincere thanks are returned to the authorities of the Johns Hopkins University. To Dr. E. A. Andrews, the director of the laboratory, the author is indebted for valuable suggestions and advice. And to the authorities of the United States National Museum a deep obligation for much timely assistance in this and many other similar investigations is acknowledged.

Digitized by Google

FISH AND FISHERIES.

The region around Montego Bay is the center of the most extensive fisheries in Jamaica. Every part of the harbor and the shore for 10 or 15 miles to the east and west of the town contributes some fish to the market.

The methods employed in catching these fish are rather crude, both the boats and the apparatus used being primitive and not very well constructed. The boats are practically all small dugouts made from native trees, and the fishing tackle consists of pots and traps, haul seines, gill nets, cast nets, and hand lines. By far the largest number of fish are taken in the pots, which consist of a wooden framework covered with split cane, bamboo, or in recent years with wire netting.

These pots are scattered all over the bottom, where it is smooth, both inside and outside of the coral reefs, in water from 1 to 12 fathoms deep, and are pulled every morning before the sea breeze roughens the surface. The haul seines are also used extensively along the numerous sandy beaches.

The actual number of food fishes obtained, as well as the number of species, is quite large, and by requesting the fishermen to save such kinds as are usually thrown away or used for bait, the number of species can readily be doubled. There were brought in for examination during the past season about 100 recorded species, nearly all of which were caught in fish pots.

A very little effort with the seine and line fishermen would easily increase this number. Again the supply of all the common species is constant for long periods of time, the same kinds being obtained daily, thus insuring an abundance of fresh material for work either with the fish themselves or with their parasites.

Of the selachians the sharks are rather scarce, only a few hammerheads (*Sphyrna zygæna*) and one or two species of *Carcharhinus* being caught during the summer, but they are said to be more plentiful at other seasons. To offset this scarcity of sharks there is an abundance of sting (Dasyatidæ) and eagle (Myliobatidæ) rays, the former often of very large size.

Among the bony fish the grunts (Hæmulidæ), the sea basses and groupers (Serranidæ), and the parrot fishes (Scaridæ) are especially numerous. The mullets (Mugilidæ), the pompanos (Carangidæ), the snappers (Lutianidæ), the croakers (Sciænidæ), and the butterfly and angel fishes (Chætodontidæ) are also abundant. The pipefishes, (Sygnathidæ), the trunk-fishes (Ostraciidæ), the puffers (Tetraodontidæ), and the porcupine fishes (Diodontidæ) can be obtained almost everywhere and in large numbers.

Digitized by Google

Beside these forms, which may be designated as the regular catch, odd species are continually being taken both in the fish pots and in the seines, and if the fishermen be induced to save these and bring them in for examination it will be found that they include during the season a good representation of nearly every family that occurs in the West Indies. In this way may often be obtained the remora (*Echeneis naucrates*), the sea-bat (*Ogcocephalus vespertilio*), the spotted moray (*Lycodontis moringa*), the cutlass fish (*Trichiurus lepturus*), the galliwasp (*Synodus fœtans*), and the flying gurnard (*Cephalacanthus volitans*), together with a host of other odd forms.

Many of the marine fish run far up into the fresh-water rivers, especially the mullets and pipefishes, but there are about a dozen strictly fresh-water species, including two or three darters, mudfish, catfish, and the like. These are not often caught by the natives but may easily be obtained with a seine. All the rivers are swift and turbulent streams except for the short deadwater near their mouths, and during the rainy season they become powerful torrents, sweeping down into the sea everything that gets caught in their current. At such times no fish can be obtained from the rivers, and even under favorable conditions the supply is limited. To escape being swept away many of the fish have acquired the habit of burrowing under the rocks or going into holes in the banks, which adds to the difficulty of securing them.

On low land to the west of the town, between the Montego River and the ocean, is a portion of the old bed of the river, which now forms a good-sized pond filled with brackish water and plentifully supplied with fish and crustacea.

This combination of salt, fresh, and brackish water furnishes exceptional facilities for the study of fish and their parasites. And it would be difficult to find a region better suited for such investigation than Montego Bay and the immediate vicinity.

PARASITIC ISOPODS.

As might be expected, parasites of all kinds were fairly common in Jamaica. But while there was a wide diversity of form and nearly every animal was more or less infested with them, the actual numbers were remarkably small. More parasites have repeatedly been taken from a single fish at Woods Hole, Massachusetts, or on the coast of Maine, than could be obtained from a score of them here in Jamaica, and to a certain extent the same was true of the crustacea and ascidians that were examined; there was the same dearth of numbers.

The parasitic isopods were about the only exception to this general rule. In the temperate regions of both the Atlantic and Pacific oceans these parasites are quite rare, but here in the tropics they are

Digitized by Google

abundant and surpass in numbers all the other parasites together. They swarm in the eye sockets and the mouth and gill cavities of many of the common fish, and are especially abundant upon the parrot fish, the grunts, and the snappers. Other species are found living as commensals within the bodies of ascidians, sponges, and the like.

A large number of specimens were obtained from these various hosts and were sent to the United States National Museum for identification and study.[1]

PARASITIC COPEPODS.

As has just been stated with reference to the isopods, it was found that a careful examination of any large fish would usually yield copepod parasites. But while there was an abundance of the isopods there would be only one or two, or at most a very few, copepods. And even large catches of fish were always disappointing in the number of copepods obtained from them. The result has been a collection of copepod parasites, very meager in the number of specimens, but comparatively rich in the number of species.

In the following list an effort has been made to include all the copepods previously reported from West Indian fish along with those found during the present investigations.

Nearly all of these published species are included in two papers, both of which are confined, so far as the West Indies are concerned, to the Danish islands in the group of Lesser Antilles.

The first paper[2] was written by Steenstrup and Lütken and published in 1861, and the second by Krøyer,[3] published in 1863.

Many of the species which they reported were obtained from preserved specimens of Danish West Indian fish in the Vienna Museum while others were brought home by the captains of various vessels which had cruised in that portion of the Atlantic.

So far as can be ascertained not a single species has hitherto been described from living material.

The present report is the exact antithesis of this, for every new species here presented has been described, and the drawings have been made, from living specimens before preservation, and in addition some of the Danish species, published in the two papers above mentioned, were obtained alive from Jamaican fish, and upon them were verified the original specific descriptions. In all there are here included 52 species, of which 21 have been previously described, while 31 are new to science.

[1] See Richardson, Proc. U. S. Nat. Mus., vol. 42, No. 1894, April 5, 1912, pp. 187–192.
[2] Kong. Danske Vid. Selsk. Skrivt., 5te. Raekke, p. 343.
[3] Naturh. Tidsskr., 3die. Raekke, p. 75.

Digitized by Google

Family ARGULIDÆ.

The apparent absence of this family from the fauna of Jamaica is worthy of comment. Species of *Argulus* have been obtained from Key West, Florida; from New Orleans, Louisiana; from Dallas, Texas, and from many localities in Central and South America. These include both salt and fresh water forms and show that in the surrounding faunas, which most resemble that of Jamaica, the family Argulidæ is fairly well represented. Hence we should naturally look for a similar representation in the Jamaican fauna, and it seems more reasonable to suppose that the failure to discover any member of this family on the fish of Jamaica has been the result of accident rather than due to their entire absence from the region. Careful search in the future may bring to light some *Argulus* species, but a similar search during the season of 1910 was unsuccessful.

Family ERGASILIDÆ.

ERGASILUS LONGIPALPUS, new species.

Plate 18, figs. 1–6.

Host and record of specimens.—A single lot, consisting of six females, was taken from the gills of several puffers (*Chilomycterus antennatus*) at Montego Bay, June 6, 1910.

Type-specimen.—Cat. No. 43512, U.S.N.M. Paratypes, Cat. No. 42258, U.S.N.M.

Female.—Cephalothorax ovate, one-fourth longer than wide, with evenly curved lateral, and a slightly reentrant posterior, margin; neither dorsal grooves nor eye visible. The first three free thorax segments the same length, but diminishing regularly in width, the first one (second segment) three-sevenths the width of the carapace; fifth segment indistinguishably fused with the genital segment, which is the same width and about twice the length of the fourth segment. Abdomen two-thirds the width of the genital segment and made up of three joints of equal length; anal laminæ small and circular, each tipped with two setæ, the inner of which is twice the length of the outer. Egg-tubes narrowed posteriorly, two-thirds the body length; eggs small, in six or eight longitudinal rows, about 20 eggs in a row.

First antennæ of the usual pattern; second pair with moderately enlarged basal joints and a stout terminal claw, bent sharply near the center and armed there with a rounded protuberance on the inner margin.

Mandibles with a slender neck, a narrow terminal blade, armed with setæ along the inner border only, and a large secondary tuft of setæ at the inner distal corner of the neck.

Mandibular palps exceptionally long and narrow, reaching beyond the tip of the basal joint almost to the center of the terminal blade.

Digitized by Google

In this they are peculiar, since in other species the tip of the palp does not project beyond the end of the basal joint. First maxilla a large knob, armed with two equal setæ; second maxilla with a large and stout basal joint and a short terminal blade, which does not reach the midline; terminal tuft of setæ short and dense.

Rami of swimming legs three-jointed, except the exopod of the fourth pair, which has but two joints; arrangement of spines and setæ as follows: First exopod, I—0, 0—1, 0—6; endopod, 0—1, 0—2, I—4. Second exopod, I—0, I—1, 0—6; endopod, 0—1, 0—2, I—5. Third exopod, 0—0, 0—1, 0—6; endopod, 0—1, 0—1, 0—5. Fourth exopod, I—0, 0—5; endopod, 0—0, 0—2, 0—4. Fifth legs wholly lacking.

Color a uniform cartilage gray, without pigment markings of any sort, quickly becoming light brown in preservatives.

Total length, 1.20 mm. Cephalothorax, 0.75 mm. long, 0.6 mm. wide. Genital segment, 0.1 mm. long and the same width. Egg strings, 0.76 mm. long, 0.20 mm. wide.

(*longus*, long, and *palpus*, a palp, alluding to the exceptional length of the mandibular palps.)

This species is difficult to distinguish except by the mouth parts, where the projection of the long and narrow palps beyond the tips of the basal mandibular joints, and the short terminal joints of the second maxillæ are very noticeable.

ERGASILUS MYCTAROTHES, new species.

Plate 18, figs. 7–12.

Host and record of specimens.—Seven females of this species, four of which carried egg strings, were taken from the mucus in the nasal tubes of a hammer-head shark, *Sphyrna zygæna*.

Type-specimen.—Cat. No. 43597, U.S.N.M. Paratypes, Cat. No. 42255, U.S.N.M.

Female.—General body form elongate and narrow; carapace elliptical, nearly twice as long as wide, narrowed about equally anteriorly and posteriorly, with shallow, but distinct, notches in the lateral margins two-fifths of the length from the posterior end, which indicate the point of union of the head with the first thorax segment. Free thorax and abdomen only two-fifths as long as the carapace and tapering rapidly posteriorly; second, third, and fourth segments the same length, but diminishing regularly in width; fifth segment so completely fused with the genital segment that there is no indication of the union either in a groove or in a pair of rudimentary fifth legs. Genital segment barrel-shaped, a little wider than long, with convex lateral margins and a pair of short, broadly rounded posterior lobes.

Abdomen three-jointed, joints diminishing regularly in length and width; terminal joint with a deep anal incision; anal laminæ con-

Digitized by Google

siderably longer than the basal abdomen joint and half as wide as the terminal joint, enlarged at the tip and armed with two large setæ, the inner of which is four times the length of the outer. Egg-cases cylindrical, as long as the entire body and twice the diameter of the genital segment; eggs rather small, in five or six longitudinal rows, from 20 to 25 in each row.

First antennæ short, only reaching the center of the basal joint of the second pair, and sparsely armed with setæ.

Second antennæ stout and two-thirds the length of the cephalothorax; basal joint moderately enlarged, the remainder of the appendage tapering regularly, with a small knob on the inner margin of the penultimate joint close to the base of the terminal claw; the latter with two small teeth on its inner margin near the center.

Labrum only indistinctly visible; mandibles large and stout, the terminal blade broad and armed with setæ around its entire margin; palps very narrow and needle-like, as long as the terminal blade and with a row of fine teeth along their outer margin; first maxillæ small, not projecting much, and armed with two small plumose setæ; second maxillæ rather large, but with small terminal joints, which overlap at the midline and are heavily armed with setæ; no visible traces of the maxillipeds.

The first three pairs of swimming legs with three-jointed rami, the exopod of the fourth pair with two joints only; the arrangement of the spines and setæ as follows: First exopod, I—0, I—0, 0—6; endopod, 0—1, 0—2, 0—5. Second exopod, I—0, I—1, 0—6; endopod, I—1, 0—2, 0—6. Third exopod, I—0, I—1, 0—5; endopod, I—1, 0—2, 0—6. Fourth exopod, I—0, 0—5; endopod, I—1, I—2, 0—5.

Color a uniform cartilage gray without pigment or markings of any sort.

Total length, 0.95 mm. Cephalothorax, 0.7 mm. long, 0.4 mm. wide. Egg-strings, 0.9 mm. long, 0.18 mm. wide.

(*μυκτηρόθεν*, out of the nose.)

This new species may be distinguished from others by the elongate elliptical shape of the cephalothorax, by the extreme shortness of the body behind the cephalothorax (see above measurements), by the great length and uniform diameter of the egg-cases, and by the thickness of the "neck" of the mandible, the width of its cutting blade, and the linear form of its palp.

BOMOLOCHUS NOTHRUS, new species.

Plates 19 and 20.

Host and record of specimens.—Fifteen specimens, including both sexes, were obtained from the gill cavity of the little fish locally known as "sheepshead," *Abudefduf saxatilis*, on September 5.

Digitized by Google

A single female was found on the gills of a tobacco fish, *Aleutera scripta*, but as this fish had been tumbled into the boat with the sheepsheads the copepod probably got on to it in some way from the latter. This single specimen is numbered 42257, U.S.N.M.

Type-specimen.—A female, Cat. No. 43590, U.S.N.M. Paratypes, Cat. No. 42253, U.S.N.M.

Female.—General body form rather short and stout; carapace twice as wide as long, squarely truncated posteriorly and with a shallow notch at the center of the frontal margin. Second, third, and fourth segments subequal in length, but diminishing regularly in width. Second segment one-third narrower than the carapace, leaving the first legs visible on either side; a part of the basal joints as well as the rami of the other swimming legs visible dorsally. Fifth segment the same length as the fourth and only a little narrower; genital segment the same width as the fifth segment and rather short, with convex sides.

Abdomen two-jointed, the basal joint wider but shorter than the terminal; anal laminæ small and rectangular, each tipped with a long inner seta, a shorter outer one, and two spines, one at the outer distal corner, the other at the center of the outer border.

Egg-strings four-sevenths of the entire length, the same width as the genital segment, and slightly narrowed at the posterior end; eggs in five or six longitudinal rows, from 15 to 16 eggs in each row.

First antennæ prominent; basal portion considerably widened and strongly arched, carrying two long tactile setæ toward its distal end. Second pair large and stout, the terminal joint tipped with two large finger-like processes, one dorsal and considerably smaller, the other ventral, and between them two long, curved claws and a straight spine. A row of bluntly rounded comb teeth runs along the anterior margin of each finger process and on to the joint itself; the row from the dorsal process stops at about the center of the joint while that from the ventral process runs the whole length of the anterior margin of the joint and curves around its proximal end to the posterior margin.

Upper lip triangular, nearly twice as wide as long, with straight sides and well rounded corners. Mandibles bent sharply backward and ending in a straight and slender spine.

First maxillæ with a long curved paragnath and a prominent knob armed with three plumose setæ, of which the two inner ones are close together, curved inward toward the midline and then backward, and are four times the length of the outer one, which is removed a little distance from them and points directly backward.

Second maxillæ curved forward and inward, not quite meeting at the midline, their terminal blades armed with a row of short hairs along the anterior margin. Maxillipeds with a large triangular basal

Digitized by Google

joint and a rather slender, strongly curved terminal claw, with a long accessory spine at the posterior curve of the S.

First swimming legs with a two-jointed exopod and a three-jointed endopod, the remaining legs with three-jointed rami, the arrangement of the spines and setæ as follows: Second exopod, I—0, I—1, II—5; endopod, 0—1, 0—2, II—3. Third exopod, I—0, I—1, III—5; endopod, I—1, I—2, I—3. Fourth exopod, 1—0, I—1, II—5; endopod, 0—1, 0—1, I—2. Fifth legs two-jointed, the basal joint much shorter than the terminal and at an angle with the latter, which is tipped with three spines of equal length.

Color a translucent cartilage gray, the ovaries, oviducts, and external egg-cases white.

Total length, 2.45 mm. Carapace, 0.65 mm. long, 1.3 mm. wide. Free segments, 1 mm. long. Egg-strings, 1.45 mm. long.

Male.—General body form wider than usual; carapace transversely elliptical, one-half wider than long, forming a blunt point on each lateral and on the frontal margin. Second, third, fourth, and fifth thorax segments the same length but diminishing regularly in width, and leaving the whole of the swimming legs visible in dorsal view. Genital segment the same width as the fourth segment, elongate acorn-shaped, with a squarely truncated posterior border and prominent well-rounded posterior corners.

Abdomen half the width of the genital segment and much shorter, two-jointed, the joints equal; anal laminæ quadrilateral, a little longer than wide and armed as in the female.

Basal portion of the first antennæ narrower and straighter than in the female; second antennæ and mouth parts the same except the maxillipeds. These are in normal position behind the other mouth parts and are three-jointed; the second joint is stout with its posterior margin swollen into a pad entirely covered with short spines which increase in size toward the distal end; the terminal claw is slender, three-fourths the length of the second joint, slightly curved, and armed along its inner margin with a row of minute saw teeth, which shut down against the spiny pad on the second joint.

Swimming legs jointed as in the female but quite differently armed; the basal exopod joint of the first pair carries a very large and flattened plumose seta on its outer margin; the terminal exopod joint of the second, third, and fourth pairs is armed with two medium spines on the outer margin and a third twice the length, or even more, at the tip; the fifth legs are smaller than in the female but similarly two-jointed.

Color the same but lacking the white of the female reproductive organs, so that the male appears considerably darker.

Total length, 1.10 mm. Carapace, 0.36 mm. long, 0.52 mm. wide. Free thorax, 0.28 mm. long.

(*νωθρὸς*, slow or sluggish.)

Digitized by Google

This species is large and fairly common in the gill cavities of the little sheepsheads. But it is noticeably sluggish in its movements and never leaves the fish on the death of the latter. On being removed and placed in an aquarium, it swims but little, attaching itself to one spot and remaining there for a long time. Even the male is not active, and in contrast with other species appears very slow and lazy.

BOMOLOCHUS ATTENUATUS, new species.

Plate 21.

Host and record of specimens.—Three females, two of which carried external egg-strings, were taken in company with *Artacolax palleucus* on the gills of the so-called "poison grouper," really one of the scorpion fishes, *Scorpæna plumieri*, August 6, 1910.

Type-specimen.—Cat. No. 43511, U.S.N.M. Paratypes, Cat. No. 42266, U.S.N.M.

Female.—General body form very elongate and slender; cephalothorax semielliptical, two-thirds wider than long, with almost regular curvature; eye small and close to the frontal margin.

Second thorax segment short, one-seventh narrower than the cephalothorax; third segment longer and three-quarters as wide as the second; fourth segment only half the length and width of the third; fifth segment as long as the third and one-fifth narrower than the fourth, formed into a sort of neck anteriorly and posteriorly. Genital segment barrel-shaped, the same width as the fifth segment and twice as long.

Abdomen nearly as long as the free thorax and genital segment together, three-jointed, the joints diminishing a little in length and width; anal laminæ twice as long as wide, and two-thirds the length of the last segment, with square corners. Each is tipped with a long inner seta, an outer one half as long, a short spine at the outer distal corner, and another at the center of the outer margin.

Egg-strings remarkably long and slender for this genus, as long as the entire body and the same width as the basal abdomen segment, which makes them 11 times as long as wide; eggs large, arranged in four longitudinal rows, from 25 to 27 in a row.

First antennæ very long and slender, the basal portion only slightly enlarged and not much curved, but carrying two long tactile setæ, and the usual large plumose seta at the distal end, pointing backward.

Second antennæ large and stout, the terminal joint tipped with a long finger process at the posterior ventral corner, a shorter one at the anterior ventral corner, with two long and strongly curved claws between them, and a larger curved claw arising from the dorsal sur-

Digitized by Google

face above the bases of the two finger processes. The whole ventral surface of the joint itself and that of the two processes are covered with diagonal corrugations.

The upper lip is one-half wider than long, with convex anterior and posterior margins, prominent lateral angles, and a small rounded process at the center of the posterior margin. It is further ornamented on the ventral surface with a wide ridge, curving inward from each lateral angle, then backward to the posterior margin, and then inward again to the median process.

The mandibles are turned backward along the posterior margin of the lip and terminate in a straight and slender spine.

The first maxillæ are each armed with three setæ, the two inner ones close together and the same length, the outer one removed a little ways from them and only one-fifth as long.

The second maxillæ are rather slender, the terminal joint being inclined forward and ending in a single smooth spine. The maxillipeds have a triangular basal joint and a stout terminal claw armed with a small and slender seta on the inner margin of the proximal curve and a large accessory spine on the outer margin of the distal curve; the basal joint carries two stout spines close together at the center of its inner margin, the anterior one twice the size of the posterior.

The first swimming legs have a two-jointed exopod and a three-jointed endopod; the second, third, and fourth legs have three-jointed rami, with the spines and setæ arranged as follows: Second exopod, I—0, I—1, III—5; endopod, 0—1, 0—2, II—3. Third exopod, I—0, II—1, II—6; endopod, 0—1, 0—2, II—2. Fourth exopod, I—0, I—1, 0—5; endopod, 0—1, 0—1, 0—3.

Color a translucent cartilage gray, oviducts white, egg-strings light gray.

Total length, 2.28 mm. Cephalothorax, 0.6 mm. long, 1 mm. wide. Free and genital segments, 1 mm. long. Abdomen, 0.9 mm. long. Egg-strings, 2.10 mm. long.

(*attenuatus*, very slender, alluding to the first antennæ, abdomen, and egg-strings.)

This species is readily distinguished by the great length and slenderness of its first antennæ, abdomen, and egg-strings, by the armature of the terminal joint of the second antennæ, and by the peculiar shape and ornamentation of the upper lip.

It is not at all a common species, since it was found on only one of the many scorpion fish examined; it is, of course, possible that this is not its regular host, but it was not found on any of the other fish examined during the season of 1910.

Digitized by Google

TUCCA IMPRESSUS Krøyer.

Tucca impressus KRØYER, 1837, p. 479, pl. 5. fig. 2*a–g*.

Host and record of specimens.—This species was very common on the fins of the various puffers, and almost every fish yielded one or more specimens of the parasite. Two lots were taken from the spiny-backed puffer, *Spheroides marmoratus*, one on June 20, the other on September 15, and have been numbered, respectively, 42265 and 42269, U.S.N.M. Two other lots were obtained from the burr fish, *Chilomycterus antennatus*, one on June 15, the other on August 8. These include by far the larger number of specimens and also both sexes of the parasite, and have been numbered, respectively, 42273 and 42251, U.S.N.M.

A single lot was obtained from the pectoral fins of the porcupine fish, *Diodon hystrix*, and has received Cat. No. 42264, U.S.N.M. This lot contains five females.

Careful search was made on these porcupine fishes for specimens of the distinct species described by Nordmann in 1864, as obtained from a *Diodon* species on the west coast of Africa, and to which the present author has elsewhere given the name *verrucosus*,[1] but none could be found.

In evidence that the habitat of these (and other) parasites is exactly restricted to certain kinds of fish, we may note the fact that although this species was so common on all the puffers, not a solitary specimen was ever found on any of the trunk fishes, and yet the latter are always associated with the puffers and are very similar to them in most respects.

ARTACOLAX PALLEUCUS, new species.

Plates 22 and 23.

Host and record of specimens.—This species was common on the gills of the "poison grouper," really one of the scorpion fishes, *Scorpæna plumieri* Bloch.

Four lots of specimens were obtained from this fish, on June 17, June 30, July 20, and July 21, 1910. These have received respectively Cat. Nos. 42272, 42324, 42252, and 42254, U.S.N.M.

Type-specimen.—A female, Cat. No. 43582, U.S.N.M.

Female.—General shape resembling a tadpole, with a large and highly inflated cephalothorax and a long and slender hind body, made up of the fifth and sixth (genital) thorax segments and the abdomen. Head and first thorax segment fully fused; second, third, and fourth segments partially fused with them to form the anterior inflated portion of the body, which is quite regularly oval in general outline, strongly arched dorsally, and filled with the uter-

[1] Proc. U. S. Nat. Mus., vol. 39, 1911, p. 359.

Digitized by Google

ine processes of the oviducts. The true cephalothorax forms about two-thirds of this anterior body and is one-half wider than long; the second segment is narrowed a little and is quite short; the fused third and fourth segments are again narrowed a little, but are rounded out posteriorly over the fifth segment, so as to be nearly twice the length of the second segment.

A minute eye is plainly visible, placed far forward, very close to the anterior margin.

In the hinder portion of the body the fifth segment is abruptly narrowed to less than half the width of the fused third and fourth segments, and is mostly concealed in dorsal view.

The genital segment is a little wider than the fifth segment anteriorly where the egg-strings are attached, but tapers posteriorly.

The abdomen is made up of three long and narrow segments, diminishing regularly in size, the basal one the same length as the genital segment. The anal laminæ are as long as the terminal abdomen segment, and each of them half as wide, tapering posteriorly and tipped with an inner seta as long as the entire abdomen, an outer one five-eighths as long, and two minute spines at the base on the outer margin.

Egg-strings spindle-shaped, slightly swollen at the center, with bluntly rounded ends; each is as wide as the genital segment and as long as the narrowed posterior body; eggs numerous, arranged in six to eight longitudinal rows, about eighteen in each row.

First antennæ long and stout, the basal portion not much enlarged, but furnished with a dense row of stout setæ along the anterior margin. Between these antennæ on the ventral margin is a stout furca pointing backward and composed of two strong spines united by a crossbar at their base.

Second antennæ large and stout, three-jointed, terminal and basal joints the same length, the middle joint less than half as long. The terminal joint is corrugated on its ventral surface and tipped with a stout claw, as long as the joint itself and well curved, with a bristling row of spines of varying lengths around its base. Mouth-parts close behind the second antennæ; upper lip triangular, one-fifth wider than long, a rounded angle turned forward while the lateral margins are straight; the lateral angles project as rounded knobs and the posterior margin is strongly convex.

Mandibles simple, turned backward beneath the upper lip and tipped with a single straight spine. First maxilla a rounded knob armed with three plumose setæ which diminish in size from within outward. Second maxilla short and stout, turned forward and armed with a small spine on the posterior margin, and tipped with two straight spines, the inner of which is twice the size of the outer. Maxillipeds reaching forward outside the other mouth parts nearly

Digitized by Google

to the anterior margin of the upper lip; the terminal claw large and stout, with a long curved accessory spine on the outer (distal) curve of the S. The basal joints of these maxillipeds are plainly visible behind the maxillæ and are connected across the midline by a wide sternum.

First swimming legs with a one-jointed exopod and a three-jointed endopod; second, third, and fourth legs with three-jointed rami, the spines and setæ arranged as follows: Second exopod, I—0, I—1, II—7; endopod, 0—1, 0—2, I—3. Third exopod, I—0, I—1, 0—8; endopod, 0—0, 0—2, II—2. Fourth exopod, I—0, I—1, 0—8; endopod, 0—1, 0—1, 0—3. The sternal plates connecting the bases of the third and fourth legs are both on the fused (third and fourth) segment, the former near the anterior margin, the latter at the center. The fifth legs are uniramose and two-jointed, the terminal joint spatulate and tipped with three spines.

Color a translucent cartilage gray, through which the snow-white uterine processes of the oviducts show prominently; the eggs are also white in younger stages of development.

Total length, 1.80 mm. Anterior inflated portion of body, 0.85 mm. long, 0.75 mm. wide. Width of genital segment, 0.28 mm. Length of egg-strings, 1 mm.

Male.—General body form elongate, almost linear; cephalothorax spindle-shaped, strongly contracted anteriorly and posteriorly, with the lateral margins projecting. Posterior body diminishing by halves, the second and third segments nearly the same width, which is half the cephalothorax, the fourth, fifth, and genital segments half the width of the preceding two, the abdomen half the width of the genital segment and two-jointed, the basal joint twice the length of the terminal; anal laminæ linear and two-thirds the length of the last joint.

Appendages similar to those of the female with the usual sexual differences. The furca on the ventral margin between the bases of the first antennæ is considerably enlarged and its rami overlap the second antennæ. The claws at the tips of the latter appendages are also much enlarged and are bent into a half circle. The maxillipeds are three-jointed, the second joint enlarged, triangular, and armed with a row of long teeth on its inner margin; terminal claw slender, curved to fit down over the second joint, beyond the proximal end of which it projects for some distance; it also has a row of fine saw teeth which fit against those on the second joint.

First swimming legs not flattened, as in the female, but with three-jointed rami like the following pairs; in the fourth endopod the two terminal joints are fused with only marginal notches to indicate the jointing; other legs as in the female.

Digitized by Google

Total length, 1.3 mm. Cephalothorax, 0.35 mm. long, 0.4 mm. wide. Free thorax, 0.37 mm. long. Anal setæ, 0.5 mm. long.

Color as in the female, the testes, sperm ducts, and sperm receptacles showing snow-white through the body walls.

(*πάλλευκος*, *πᾶς* and *λευκός*, all white.)

This species is a very common one on the gills of the scorpion fish, nearly every fish examined being infested. The females were found fastened to the skin on the inside of the gill arches and occasionally on the filaments. The males were always fastened to the filaments.

The hold of both sexes is rather a loose one and is easily broken, and they seem to move about freely over the gills. When removed to an aquarium they fasten readily to the glass and hold on as well as to the gills. They also swim about easily and quite rapidly and may be kept alive for several days. They can not, however, crawl up out of the water like the Caligidæ, but always remain beneath the surface.

This is the first male to be described for the new genus *Artacolax*, and it is interesting to note some differences between it and a typical *Bomolochus* male. These consist chiefly in the anterior marginal furca, the huge claws at the tips of the second antennæ, and in the peculiar shape of the second joint and terminal claws of the maxillipeds.

PSEUDOEUCANTHUS UNISERIATUS, new species.

Plate 24.

Host and record of specimens.—A single lot consisting of three females with egg-strings was obtained from the mouth of the yellow jack, *Caranx crysos*, August 1, 1910.

Type-specimen.—Cat. No. 43510, U.S.N.M. Paratypes, Cat. No. 42256, U.S.N.M.

Female.—General body form long and narrow; cephalothorax transversely elliptical, one-sixth wider than long; frontal margin projecting as a rounded knob between the bases of the antennæ.

Carapace not reaching the lateral margins, its posterior corners prominent and rounded, overlapping the second thorax segment; no dorsal grooves; eye small and situated very far forward, almost between the bases of the antennæ. Second segment half the width of the cephalothorax and very short; third segment a little wider and considerably longer, with projecting posterior corners; fourth segment the same width as the second and as long as the third, strongly contracted posteriorly; fifth segment a little narrower than the fourth and about half as long, its lateral margins projecting angularly over the bases of the fifth legs; sixth or genital segment the same width as the fifth and two-thirds as long, its lateral margins strongly convex.

Digitized by Google

Abdomen abruptly contracted to half the width of the genital segment, three-jointed, the joints diminishing slightly in width and considerably in length; anal laminæ narrow oblong, three times as long as wide and about the same length as the two terminal abdomen joints.

Each lamina is tipped with a large papilla carrying a long and stout seta, and with four short spines, three at the tip and one on the outer margin.

Egg-strings one-sixth longer than the entire body; eggs large and *uniseriate* except for a short distance near the base where there are two rows, 30 to 35 eggs in each string.

First antennæ not enlarged at the base, but with a row of wide and flattened setæ along the anterior margin; segmentation indistinct but apparently made up of five joints.

Second antennæ with a slightly enlarged terminal joint, tipped with a fleshy finger-like process and two long curved claws.

Extending along the anterior margin of the joint and to the tip of the finger process is a row of blunt teeth; the surface of the joint is also covered with corrugated ridges.

Upper lip large and shield-shaped, with prominent rounded anterior corners and a three-lobed posterior margin. Mandible directed backward and ending in a smooth, needle-like spine. First maxilla with a distinct basal portion and a prominent knob armed with three plumose setæ, the central one of which is nearly twice the length of the other two. Second maxilla with a long and swollen basal joint curved forward toward the end and tipped with two short and stout spines covered with hairs. Basal joint of the maxillipeds partly visible behind the maxillæ; second joint curved around the outside of the second maxilla and greatly elongated so that it reaches in front of even the second antennæ; terminal claw moderately bent and following the inner margin of the second joint, without accessory spines or setæ.

Exopod of first swimming leg turned forward and two-jointed, terminal joint much longer than the basal; endopod extending backward and three-jointed. Second, third, and fourth legs with three-jointed rami, each joint of the exopod armed on the outer margin with short saw teeth and one or more long spines; arrangement of the spines and setæ as follows: Second exopod, I—0, I—0, II—3; endopod, 0—1, 0—2, II—3. Third exopod, I—0, I—0, III—3; endopod, 0—1, 0—1, I—3. Fourth exopod, I—0, I—0, III—3; endopod, 0—1, 0—1, I—2. Fifth legs uniramose but wider and longer than any of the others, each tipped with three spines and carrying a fourth on the outer margin.

Digitized by Google

Uterine processes of the oviducts filling the posterior fourth of the cephalothorax and the second, third, and fourth segments, sending a branch out into the base of each of the swimming legs.

Color a dark gray, the cephalothorax nearly transparent, the uterine processes snow-white.

Total length, 1.25 mm. Cephalothorax, 0.5 mm. long, 0.45 mm. wide. Free thorax, 0.5 mm. long, 0.25 mm. wide. Egg-strings, 1.5 mm. long, 0.1 mm. wide.

(*uniseriatus*, arranged in a single series, alluding to the eggs.)

The present genus was created by Brian in 1906 for some parasites which had been obtained from the eye of "*Clupea alosa*." The naming of the genus was unfortunate in every particular. The name *Eucanthus* given by Claus had been preoccupied many years before for a genus of coleoptera and hence can not stand. We thus have a *Pseudoeucanthus* but no *Eucanthus*.

Again, Claus's genus was distinguished from *Bomolochus* by the presence of maxillary hooks and by the normal position of the maxillipeds behind the other mouth parts. Brian's genus shows neither of these peculiarities but has the mouth parts like those of *Bomolochus*, and might far better have been called *Pseudobomolochus*. Indeed, while it is easily distinguished from *Eucanthus* (*Anchistrotos*), what it really demands is a better separation from *Bomolochus*. This may be stated as follows: First antennæ neither enlarged nor curved at the base and destitute of tactile setæ; maxillipeds without plumose setæ or accessory spines; exopod segments of the second, third, and fourth legs fused and only the terminal joint armed with plumose setæ; single ramus of the fifth legs longer and wider than any of the others; each anal lamina tipped with a single-jointed seta and small spines; genital segment very short and carrying rudimentary sixth legs; eggs very large, in two rows only or even mostly uniseriate, forming strings similar to those in the Caligidæ and unlike the rest of the Ergasilidæ.

These specimens, obtained and examined alive, enable us to decide all those points in Brian's original description which needed confirmation or correction.[1]

1. There are four free segments in front of the genital segment as in *Bomolochus*. The first of these, really the second thorax segment, is very short and narrower than the third segment. This segment is not indicated in Brian's figures or description.

2. This genus possesses first maxillæ similar to those in the other genera of the family.

3. The specimen figured by Brian as a "male(?)" was really a female without egg-strings.

[1] See Proc. U. S. Nat. Mus., vol. 39, p. 381.

Digitized by Google

TÆNIACANTHUS FLAGELLANS, new species.

Plate 25, figs. 54–61.

Host and record of specimens.—Six females with egg-strings were obtained from the gill cavity of the hammer-head shark, *Sphyrna zygæna*, at different times, two being the largest number from any single shark.

Type-specimen.—Cat. No. 43517, U.S.N.M. Paratypes, Cat. No. 42261, U.S.N.M.

Female.—General body form elongate and narrow, especially posteriorly; cephalothorax turned over ventrally so as to stand at right angles to the rest of the body axis; ventral surface of this cephalothorax prolonged into a sucking disk which protrudes beyond all the mouth parts and is surrounded by a membranous edge, similar to that on the sucking disks of *Argulus*.

The first antennæ lie along the anterior portion of this edge while the first legs curve around the posterior portion and both no doubt aid in attaching and releasing the disk.

Cephalothorax triangular in dorsal outline, with rounded corners, considerably wider than the second (first free) segment, and entirely covering the antennæ, mouth parts, and first legs. Second to fifth segments about the same length but diminishing regularly in width, and showing successively larger portions of the swimming legs, until the whole of the fifth pair appears in dorsal view. Genital segment the same width as the fifth segment and nearly twice as long, tapering posteriorly.

Abdomen composed of four segments, diminishing regularly in size, except that the third one is a little shorter than the last. Anal laminæ narrow, two-thirds the length of the last segment, each tipped with two setæ of which the inner one is half as long again as the outer. Egg-cases attached to the anterior end of the genital segment on the dorsal surface, their bases covered by the rudimentary sixth legs. Each case is about the same diameter as the abdomen and reaches to the center or even the tips of the longest anal setæ; eggs numerous, arranged in six or seven longitudinal rows, 18 or 20 eggs in a row.

Basal portion of first antennæ not much enlarged, indistinctly divided into three parts, with a fringe of large flattened setæ along the anterior margin; terminal portion made up of three distinct segments, heavily armed with setæ.

Second antennæ three-jointed and tipped with three long curved claws, the ventral surface of the terminal joint being corrugated.

Mouth parts close to the second antennæ; upper lip two and a half times as wide as long, the two anterior margins slightly concave, the posterior one convex. Mandibles three-jointed, the two distal joints bent backward at an angle with the basal joint; the terminal joint a simple straight spine. First maxilla armed with three setæ

Digitized by Google

of about the same length. Second maxilla tipped with two spines, the posterior one twice the size of the anterior. Maxillipeds with the terminal joint bent back against the basal and tipped with two spines, the outer (posterior) of which is twice the size of the inner. Behind the bases of the maxillipeds, on either side of the midline and close to it, is a short accessory spine.

Each ramus of the first legs is two-jointed, those of the second, third, and fourth legs three-jointed, with the arrangement of the spines and setæ as follows: Second exopod, I—0, I—1, II—7; endopod, 0—1, 0—2, II—4. Third exopod, I—0, I—1, II—6; endopod, 0—1, I—2, II—3. Fourth exopod, I—0, I—1, I—6; endopod, 0—1, I—2, II—3. Fifth legs two-jointed, the terminal joint enlarged and tipped with four spines.

Ovaries in the lateral portions of the cephalothorax; oviducts extending back along the lateral margins of the free thorax segments, sending out short and stout uterine processes into each segment.

Color a clear cartilage gray, the ovaries and processes white.

Total length, 3 mm. Cephalothorax, 0.70 mm. long, 0.98 mm. wide. Free thorax, 1 mm. long. Egg-cases, 1.5 mm. long.

(*flagellans*, flagellating or lashing, in allusion to the lashing motions when disturbed.)

This genus was established by Sumpf (1871) upon some specimens obtained from the gills of *Carcharias* (*Carcharhinus*) *lamia*. A new species was added by the present author in 1910 obtained from the vent of the bonnet-head shark, *Sphyrna tiburo*. The present is a third species from the gills of the hammer-head, and having been studied alive some notes can be added on the habits of the genus. All the specimens were found attached to the skin of the gill partitions just outside of the filaments. When detached and placed in an aquarium they swim about as freely as pelagic forms and may be kept alive for several days. The ventral disk protrudes like a sucker's mouth and is the chief organ of attachment, thus emphasizing one of the chief differences between the subfamilies of the Ergasilidæ. In the Ergasilinæ there is no ventral disk and attachment is entirely by means of the second antennæ; in the Bomolochinæ there is such a disk, but the stout claws on the maxillipeds show that they play an important part in attachment; here in the Tæniacanthinæ the ventral disk is fully developed, and is the only organ of attachment, the antennæ and maxillipeds having degenerated beyond practical use. The parasites catch on and let go with great ease and celerity and adhere to glass as readily as to the fish's gills. When thus attached the long thorax and abdomen are lashed about actively, especially upon irritation, and this peculiar habit is sure to attract attention to the copepod. When the gills are placed in water the parasites leave them quickly and swim about, usually without returning to them again.

Digitized by Google

Family CALIGIDÆ.

CALIGUS PRODUCTUS Dana.

Caligus productus DANA, 1854, p. 1354, pl. 94, fig. 4.

Host and record of specimens.—This species was originally described by Dana from specimens obtained from the common dolphin, *Coryphæna hippurus*, and from trigger fishes, *Balistes*, in the West Indies. It was afterward noted by Steenstrup and Lütken (1861, p. 357) as taken from the inside of the operculum of the barracuda, *Sphyræna barracuda*, and by Krøyer (1863, p. 64) as found on the same *Coryphæna* as Dana's specimens. In both of these instances the locality given was the Danish West Indies.

CALIGUS BALISTÆ Steenstrup and Lütken.

Caligus balistæ STEENSTRUP and LÜTKEN, 1861, p. 356, pl. 1, fig. 1.

Host and record of specimens.—This species was originally obtained from the mouth and fins of a West Indian *Balistes*, probably *B. vetula*, and included both sexes. It has not been found by any subsequent investigators.

CALIGUS ISONYX Steenstrup and Lütken.

Caligus isonyx STEENSTRUP and LÜTKEN, 1861, p. 358, pl. 3, fig. 5.

Host and record of specimens.—This species is based on a single female taken from the gills of a great barracuda, *Sphyræna barracuda*, in the West Indies. No other specimen has ever been obtained.

CALIGUS HÆMULONIS Krøyer.

Caligus hæmulonis KRØYER, 1863, p. 48, pl. 4, fig. 3*a–d*.

Host and record of specimens.—Three specimens, two females and a male, of this species were taken from the gills of the yellow grunt, *Hæmulon sciurus* (*H. elegans* Cuvier), in the Danish West Indies. No other specimens have ever been obtained.

CALIGUS TENAX Heller.

Plate 26; plate 29, figs. 99–101.

Caligus tenax HELLER, 1865, p. 172, pl. 15, fig. 3.

Host and record of specimens.—The original type-specimens were obtained from the gills of the horse crevalle, *Caranx hippos* (*C. carangus* of Heller), in Brazil. These included females only. Later (1898) Bassett-Smith reported both sexes from various species of *Caranx* in the Indian Ocean. Both sexes were also obtained from the gills of *Caranx crysos* July 12, and from *Caranx hippos* July 29, 1910, and have received Cat. Nos. 42301 and 42341, U.S.N.M.

Female.—General body form long and stout; carapace ovate, one-sixth wider than long, strongly contracted anteriorly; frontal plates prominent; lunules semicircular, projecting half their width; frontal

Digitized by Google

margin straight, deeply incised at the center; lateral areas very wide; lateral lobes also wide and short, curved strongly inward and almost squarely truncated at the ends; median lobe a little more than one-third the width of the carapace, with projecting corners which overlap the lateral lobes, and an emarginate posterior border. Eye minute, one-third the length of the carapace behind the anterior margin. Free segment short, two-sevenths the width of the carapace; genital segment acorn-shaped, three-fourths the length and half the width of the carapace, with wide and bluntly rounded posterior lobes.

Abdomen one-jointed, three-sevenths of the width and a little more than half the length of the genital segment; anal laminæ minute, widely separated, each tipped with four short setæ.

Egg-tubes three-fourths the width of the abdomen and a little more than half the length of the body.

Terminal joints of the first antennæ very slender, much longer than the basal joints, ten times as long as wide. Second antennæ rather slender, with a long terminal claw bent at a right angle near the tip. Maxillary hooks short and nearly straight, with a strongly inflated base; first maxillæ short and triangular, with a small secondary spine near the center of the inner margin. Maxillipeds with a stout terminal claw fully as long as the moderately inflated basal joint and strongly curved. Furca with an exceptionally broad, three-lobed base and the short rami curved so as to form together a half circle. First swimming legs with a very rudimentary one-jointed endopod, and with short plumose setæ on the terminal joint of the exopod; second legs with medium-sized spines on the exopod, whose second joint carries an exceptionally wide rowing seta; rami of third legs close together, the spine on the exopod long and stout and bent into a half circle; fourth legs four-jointed with five spines subequal in length.

Cement glands situated far forward in the genital segment and inclined outward, the divisions of the glandular portion showing like a string of beads through their center.

Color a clear cartilage-gray, very translucent except toward the margin, with ten small circular pigment spots of dark bluish-purple on the dorsal surface of the carapace, arranged in pairs.

Total length, 4 mm. Carapace, 1.75 mm. long, 2 mm. wide. Genital segment, 1.3 mm. long, 1 mm. wide. Abdomen, 0.8 mm. long, 0.5 mm. wide. Egg-strings 2.25 mm. long, 0.33 mm. wide.

Male.—Carapace in all respects similar to that of the female, but proportionally larger; free segment longer and contracted into a neck anteriorly and posteriorly; genital segment barrel-shaped, with moderately curved sides and small posterior lobes closely approximated to the sides of the abdomen, which latter is almost as wide as

Digitized by Google

the genital segment and indistinctly two-jointed, the basal joint much the shorter; anal laminæ small and circular, each tipped with three long setæ and a shorter one on the lateral margin.

Terminal joints of the first antennæ even longer and more slender than in the female.

Second antennæ with a much longer second joint and a shorter terminal claw, curved into a horseshoe shape. Maxillary hooks longer and more slender but straight; other appendages like those of the female except that both the fifth and sixth legs are present on the genital segment, the former on the lateral margins opposite the sperm receptacles, the latter forming the posterior lobes.

Color as in the female.

Total length, 2.85 mm. Carapace, 1.6 mm. long, 1.7 mm. wide. Genital segment, 0.65 mm. long, 0.45 mm. wide.

Heller's description of the female of this species was good and such figures as he presented were excellent, but both were made from preserved material alone and lacked many details. Bassett-Smith's description of the male is far from satisfactory and his single figure gives no details whatever.

The present specimens having been obtained alive and kept for several days, an attempt has been made to give a complete description from them, particularly with regard to color and proportions. Among these specimens were two chalimus larvæ; in the smaller one only the first thorax segment was fused with the carapace and the endopod of the first legs was as large as the exopod. In the larger one the first two thorax segments were fused with the carapace and the first endopod had become very rudimentary. Both sexes swim about in an aquarium almost constantly and are fully as lively as *C. rapax*. The species is not a common one, for among the large number of jacks examined during the season only two were found infested with this parasite. One of these, however, yielded a dozen specimens, which was an exceptionally large number.

CALIGUS IRRITANS Heller.

Plate 25, fig. 62; plate 27.

Caligus irritans HELLER, 1865, p. 177, pl. 15, figs. 7 and 8.

Host and record of specimens.—A male and female of this species were obtained from the gills of a large (12 pounds) red snapper, *Neomænis aya*, on July 22, 1910. They have been given Cat. No. 42262, U.S.N.M.

Female.—General body form long and stout; carapace ovate, longer than wide and one-fourth shorter than the rest of the body; frontal plates prominent, lunules enormous and circular, separated by a distance equal to their own diameter; lateral areas narrow, lateral lobes curved inward at their tips and bluntly rounded;

Digitized by Google

median lobe half the diameter of the carapace, with a nearly straight posterior margin on a level with the tips of the lateral lobes.

Free segment short, about one-fourth the width of the carapace; genital segment shaped like a broad acorn with a slightly reentrant posterior margin, three-fourths the size of the carapace, without lobes or fifth legs.

Abdomen two-jointed, basal joint considerably the longer; one-third the width and five-sevenths the length of the genital segment; anal laminæ short and wide, each tipped with five setæ.

Of the appendages the maxillary hooks have an inflated circular base and a long and strongly curved ramus. First maxillæ slender and extending considerably beyond the tip of the mouth; rudimentary endopods present, each tipped with a single spine.

Mouth tube very short and wide, in fact almost circular in ventral outline. Terminal claw of maxillipeds less than two-fifths of the length of the basal joint, stout and strongly curved, with a spine on its inner margin. Furcæ long and narrow, contracted at the base of the rami, which are slender, bluntly rounded and curved like parenthesis marks. First swimming legs short and stout, with two spines on the ventral surface of the basal joint at the distal end and one on the posterior margin; rami of second legs equal in length, the spines on the exopod slender and weak; rami of third legs well separated, short and wide; fourth legs three-jointed with five subequal spines. Cement glands divergent, with their bases close to the midline, the beaded portion narrow and extending through the center of the gland.

Color a uniform cartilage-gray without pigment marks of any sort.

Total length, 4.16 mm. Carapace, 1.83 mm. long, 1.6 mm. wide. Genital segment, 1.25 mm. long, 1 mm. wide. Abdomen, 0.92 mm. long, 0.35 mm. wide.

Male.—Carapace similar in all respects to that of the female, but proportionally larger, the medium lobe projecting a little behind the lateral lobes; genital segment barrel-shaped, with strongly convex sides and straight anterior and posterior margins; both the fifth and the sixth legs present, the former just behind the center of the lateral margin and tipped with a single spine, the latter farther back and more prominent, tipped with two spines.

Basal abdomen joint considerably shorter than the terminal; anal laminæ long and wide, each tipped with four setæ.

Second antennæ with a swollen and corrugated basal joint and an exceptionally short and stubby terminal claw; maxillary hooks enlarged so that they are longer and stouter than the entire second antennæ. Maxillipeds with a strongly swollen basal joint armed with five large saw teeth on its inner margin, against which the terminal claw shuts when closed.

Digitized by Google

Furca much narrower than in the female and somewhat different in shape. (See fig. 72.)

Color like that of the female.

Total length, 3.5 mm. Carapace, 2 mm. long, 1.5 mm. wide. Genital segment, 0.57 mm. long, 0.48 mm. wide.

This species was originally described by Heller from specimens obtained on the gills of a *Serranus* species from Brazil and has not been seen since. The present specimens differ in several of the minor details but are undoubtedly the same species. They are here redescribed to confirm Heller's species, to show the variations in minor details, and to emphasize the distinguishing characters. These latter are to be found in the general body proportions, the exceptionally large lunules, the very short and almost circular mouth tube, and in the male the stubby claws on the second antennæ, the greatly enlarged maxillary hook and the stout, toothed basal joints of the maxillipeds.

The species is very rare, only the single pair being obtained during the entire season.

CALIGUS ROBUSTUS Bassett-Smith.

Plate 28.

Caligus robustus BASSETT-SMITH, 1898, p. 361, pl. 11, figs. 1-2.

Host and record of specimens.—A male and female were obtained from the gills of the red-mouthed grunt, *Bathystoma rimator*, July 14, 1910, and have received Cat. No. 42260, U.S.N.M. Two much larger females were afterwards found upon the gills of the crevalle, *Caranx crysos*, and were given Cat. No. 42268, U.S.N.M.

Female.—General body form short and stout; carapace ovate, as wide as long; frontal plates narrow and not prominent; lunules small, circular, and projecting moderately; lateral areas very wide and terminating in wide and blunt posterior lobes; median lobe three-sevenths the entire width and reaching but little behind the lateral lobes; posterior sinuses shallow with parallel sides.

Eye medium-sized and placed far forward, one-fifth the length of the carapace behind the anterior margin.

Free segment nearly one-third the width of the carapace, strongly contracted anteriorly and posteriorly. Genital segment broad acorn-shaped, a little wider than long, with the lateral margins strongly convex, the posterior margin nearly straight, the corners evenly rounded without lobes, and the fifth legs visible just outside the bases of the egg strings. Abdomen less than one-fourth the width of the genital segment and considerably shorter, two-jointed, basal joint twice the length of the terminal.

Anal laminæ large and inclined toward each other, each tipped with three setæ of equal length and two short spines on the outer

Digitized by Google

margin. Egg-strings half the entire length, each one-third wider than the abdomen and containing 20 to 25 eggs.

First antennæ short, not reaching the lateral margin of the carapace; second pair with a stout basal joint but a weak and slender terminal claw. Maxillary hooks minute, with an inflated circular base and a very short tip; first maxillæ long, wide, and bluntly rounded at the tip, projecting well beyond the mouth tube, which is short and wide. Maxillipeds with a stout basal joint bearing an enormous broad spine on its inner margin and a much smaller secondary one at its base. The point of the terminal claw, which is stout and less than half the length of the basal joint, shuts in between the two spines. Furca stout, contracted at the center and enlarged at either end, the rami broadly laminate, bluntly rounded, and nearly straight.

Exopod of the second swimming legs shorter than the endopod and armed with very long and acuminate spines; rami of third legs well separated, exopod long and narrow with a medium-sized bluntly pointed spine; fourth legs stout, the three terminal joints nearly as wide as the basal, the five spines subequal; fifth legs each tipped with two spines.

Color a uniform white, without pigment markings of any sort.

Total length, 4.2 mm. Carapace, 2 mm. long, 2 mm. wide. Genital segment, 1.1 mm. long, 1.3 mm. wide. Abdomen, 1 mm. long, 0.27 mm. wide. Egg-strings, 2 mm. long. The females from *Caranx crysos* had a total length of 7 mm., with the other measurements in proportion.

Male.—Carapace and free segment similar to those of the female, the former a little more than half the entire length. Genital segment less than a third the width of the carapace, barrel-shaped, with strongly convex sides and short posterior lobes; fifth and sixth legs both present, the former just behind the center of the lateral margins, the latter forming the posterior lobes.

Abdomen two-jointed but with the terminal joint three times the length of the basal; anal laminæ large and inclined toward each other, each tipped with three long setæ and a fourth shorter one on the outer margin. Appendages like those of the female without even the customary differences in the second antennæ, maxillary hooks, and maxillipeds.

Color like the female.

Total length, 2.64 mm. Carapace, 1.35 mm. long, 1.36 mm. wide. Genital segment, 0.43 mm. long and the same width.

Bassett-Smith's original specimens were obtained from the operculum or gill rays of various species of *Caranx* and *Thynnus* from the Indian Ocean. The specimens from the red-mouthed grunt are much smaller than his but there can be no doubt they are the same

Digitized by Google

species, while the two from the jack are fully as large as his. As Bassett-Smith says, the species somewhat resembles *Caligus irritans* Heller, but it shows these differences. The genital segment in both sexes is much shorter and wider, the abdomen is narrower, the maxillary hooks are not enlarged in the male, the maxillipeds are alike in the two sexes and very different from either sex in *irritans*, the furca is much stouter and often contracted at the center, and the details of the swimming legs are quite different, especially the fourth pair.

In the two large females from the jack the contents of the digestive tube showed dark bluish-black by transmitted light, and the ventral surface of the genital segment was covered with an irregular pattern of fine bluish-purple lines.

As the species has been seen only by Bassett-Smith, and as the present locality is far removed from the Indian Ocean, it has been deemed wise to give a new description and figures.

CALIGUS ATROMACULATUS, new species.

Plate 29, figs. 92–98.

Host and record of specimens.—Two females, both with egg-strings, belonging to this tiny species were found fastened to the gill filaments of the doctor fish, *Teuthis hepatus*.

Type-specimen.—Cat. No. 42348, U.S.N.M.

Female.—General body form short and stout; carapace about half the entire length, a little longer than wide; frontal plates projecting prominently; lunules large, circular, and close to the mid-line; frontal margin straight without any median incision; cross-bar of the H groove curved forward so that its center is close behind the eye; lateral areas only one-seventh the width of the thoracic area, lateral lobes pointed and curved inward; posterior sinuses narrow and deep; median lobe almost squarely truncated posteriorly and projecting but little behind the lateral lobes.

Eye large and placed about one-fourth of the length of the carapace behind its anterior margin.

Free segment short and contracted into a waist anteriorly; genital segment ovate, one-third the entire length, with evenly rounded sides and corners and a squarely truncated posterior margin, without lobes or fifth legs.

Abdomen minute, one-fourth the length and width of the genital segment; anal laminæ spherical and well separated, each tipped with five setæ, the three middle ones three times the length of the other two.

Egg-strings very wide and short, each nearly half the width and the same length as the genital segment and containing a dozen eggs.

First antennæ short and slender, the tips just reaching the lateral margins of the carapace; second pair stout, the terminal claw much longer than the basal joint and bent near its tip; maxillary hooks

Digitized by Google

three-quarters as large as the terminal claws of the second antennæ, slender, and curved but slightly; maxillæ reaching well beyond the end of the short and wide mouth tube, slender, with an enlarged and bluntly rounded tip; maxillipeds small, the terminal claw weak and only half the length of the basal joint. Furca proportionally large, the basal part subquadrilateral with the sides slightly reentrant, the rami one-half longer than the base, nearly parallel, with flattened spatulate tips.

Claws on the exopods of the second legs long and slender; rami of the third legs small and well separated; fourth legs (including their spines) reaching nearly to the posterior margin of the genital segment, but slender, with a short spine on the outer margin of the basal joint near its distal end, a long terminal spine at the tips of the second and third joints and two on the terminal joint, of which the inner is twice the length of the outer.

Color a clear cartilage gray, thickly covered on the dorsal surface with small spots of jet black; these spots are circular in outline and are thickest along the midline where they extend the entire length of the body.

Total length, 2.05 mm. Carapace, 1.1 mm. long, 0.95 mm. wide. Genital segment, 0.65 mm. long and the same width. Abdomen, 0.15 mm. long. Egg-strings, 0.8 mm. long.

(*atromaculatus*, *ater*, black, and *maculatus*, spotted.)

This tiny species proved to be very sluggish when transferred to an aquarium and did not swim about at all, simply lying on its back and moving its appendages feebly. Its distinguishing characters are the black spots on the dorsal surface, the large circular lunules, the spatulate tips of the first maxillæ, the long and club-shaped rami of the furca, and the weak and slender fourth legs.

CALIGUS AFURCATUS, new species.

Plate 30, figs. 102–106; plate 32, figs. 136–138.

Host and record of specimens.—Three females with egg-strings were found fastened to the sides of the filaments, in the spaces between adjacent filaments, on the gills of an 8-pound green parrot fish, *Pariscoma viride*, in company with the following species.

Type-specimen.—Cat. No. 43518, U.S.N.M. Paratypes, Cat. No. 42259, U.S.N.M.

Female.—General body form short and stout; carapace ovate, one-eighth longer than wide, narrowed anteriorly; frontal plates narrow and not prominent; lunules small, widely separated, circular, and not projecting; eye small; lateral areas narrow, lateral lobes bluntly rounded and inclined inward; median lobe half the entire width and projecting for half its length behind the lateral lobes; posterior sinuses narrow and inclined outward; crossbar of the H grooves convex

Digitized by Google

anteriorly, crossing the midline at the center of the carapace. Free segment short, one-fourth the width of the carapace and swollen through the bases of the legs. Genital segment ovate, with strongly convex sides and short, broad posterior lobes.

Abdomen minute, triangular, one-jointed; anal laminæ long and narrow, each tipped with four tiny spines.

Egg-strings three-fourths as long as the entire body, each containing about 30 eggs.

First antennæ small, the joints about the same length; second pair large, with a long and slender terminal claw bent into a half circle. Maxillary hooks so minute as to be scarcely visible; first maxillæ reduced to mere pimples at the sides of the mouth tube, short and bluntly rounded but still retaining the rudimentary exopod tipped with two spines. Maxillipeds long and slender, basal joint three and a half times as long as wide, terminal claw stout and acuminate, shorter than the basal joint and not much curved. First swimming legs also long and slender, the terminal joint with only two claws at the end and three weak setæ on the posterior border. Terminal joint of the exopod of the second legs long and wide, spine on the basal joint narrow and acuminate, spines on the two terminal joints exceptionally small and short. Rami of third legs well separated, claw on the exopod short, stout, and straight, the joints longer than usual and well armed with setæ and spines. Fourth legs three-jointed, the two terminal of the usual four joints being fused; basal joint a little longer than the rest of the leg and carrying a good-sized spine on its outer margin near the distal end; the inner terminal spine about twice the length of the other four, which are subequal.

Cement glands short and stout and inclined away from the midline with their convex sides toward it.

Color a dark cartilage-gray, ornamented on the dorsal surface of the entire body, and on the ventral surface of the abdomen, with an intricate network of fine lines of dark bluish-purple.

Total length, 2.32 mm. Carapace, 1.4 mm. long, 1.25 mm. wide. Genital segment, 0.75 mm. long, 0.65 mm. wide. Egg-strings, 1.9 mm. long.

(*afurcatus*, *a*, not, and *furcatus*, provided with a furca.)

This species bears some resemblance to *C. baliste*, but may be easily distinguished by the much shorter abdomen, by the absence of a furca, by the degenerate form of the maxillary hooks and first maxillæ, and by the fact that the fourth legs have five spines instead of only four. The only other *Caligus* species which possess as short an abdomen are Krøyer's *C. abbreviatus* and the species which here follows, *C. enormis*.

From the former the present species may be distinguished by the absence of a furca and the fifth legs, and by the presence of six spines

Digitized by Google

on the fourth legs instead of four; from the latter it may be distinguished at once by the relative size and shape of the carapace and abdomen.

CALIGUS ENORMIS, new species.

Plate 31.

Host and record of specimens.—A dozen specimens, including both sexes, were found clinging to the inside of the gill filaments of the same 8-pound green parrot fish, *Sparisoma viride*, that served as the host of the preceding species.

Type-specimen.—A female, Cat. No. 43593, U.S.N.M. Paratypes, Cat. No, 42263, U.S.N.M.

Female.—General body form elongate and narrow; carapace and genital segment approximately the same size, each of them being constricted where it joins the fourth (free) segment, thus giving the body somewhat the shape of a dumb-bell. Carapace only three-sevenths of the entire length, elliptical, one-third longer than wide; frontal plates narrow and prominent; lunules reduced to narrow lines with scarcely any curve, close together, with no incision in the short frontal margin between them. Eye large and placed well forward. Lateral areas wide, the posterior lobes turned slightly outward; median lobe twice the width of the lateral lobes and reaching more than half its length behind them; posterior sinuses broad and shallow.

Free segment one-third the width of the carapace, with convex lateral margins. Genital segment elliptical, the same length as the carapace but a little narrower, with rounded corners and nearly straight sides.

Abdomen reduced to a comparatively minute protuberance at the posterior end of the genital segment, triangular and one-jointed; each anal lamina as large as its half of the abdomen and tipped with three short setæ and a fourth one on the outer margin.

Egg-strings exceptionally short and wide, similar to those found in many Dichelestiids, each half the width of the genital segment and not quite equaling it in length; only six or seven eggs in each string.

First antennæ short and stout, not reaching more than halfway to he lateral margins, the two joints about the same length and well armed. Second pair with a slender terminal claw, slightly bent near the tip. Maxillary hooks and first maxillæ reduced to tiny spines that can hardly be detected; second maxillæ exceptionally large and stout, the two joints about the same size, the terminal claws short and stout. Maxillipeds with a swollen basal joint and a strong terminal claw carrying an accessory spine on its inner margin toward the tip. Furca entirely lacking. First swimming legs rudimentary, made up of three short and wide joints of about the same size, the terminal one with four claws at the tip but no setæ on the posterior margin. Exopods of second pair extending outward in line with the basal joint

Digitized by Google

and at right angles to the body axis, and appearing in dorsal view just behind the posterior lobes of the carapace; the endopod is carried at right angles to the exopod, or parallel to the body axis. Third legs reduced far more than is usual in the genus, the spine on the exopod straight instead of curved, the terminal joint with four spines but only a single seta; the endopod contains but one partial joint, which is fused to the basal plate. Fourth legs stout and of the usual pattern, three-jointed, the inner terminal spine two and a half times as long as the other four which are about equal. Fifth legs present just in front of the posterior corners of the genital segment, the endopod represented by a single spine, the exopod by a papilla tipped with two spines.

Color a light cartilage-gray, exceptionally translucent and ornamented on the dorsal surface of the carapace with a few scattered and irregular spots of purple pigment.

Total length, 2.15 mm. Carapace, 0.95 mm. long, 0.75 mm. wide. Genital segment, 0.9 mm. long, 0.6 mm. wide. Egg-strings, 0.8 mm. long, 0.28 mm. wide.

Male.—General form narrow and elongate; carapace exactly like that of the female, but the posterior body much narrower. Lunules larger and semicircular; eye farther back in the carapace; posterior sinuses even shallower than in the female.

Genital segment barrel-shaped, considerably less than half the width of the carapace and just about half the length.

Abdomen two-thirds as wide and three-fifths as long as the genital segment; anal laminæ large, each tipped with three medium-sized setæ and two short spines on the outer margin.

Appendages like those of the female, with the following exceptions: The first antennæ reach fully to the lateral margins of the carapace; the terminal claw on the second pair has the usual accessory spines and corrugated surfaces found in the male sex; the maxillary hook is enormously enlarged, so that it is larger than the claw on the second antenna; the basal joint of the maxilliped is much swollen, and is armed with a stout spine on its inner margin, which interlocks with the tip of the terminal claw; the accessory spine on the latter claw is close to the base instead of near the tip.

Color as in the female.

Total length, 1.6 mm. Carapace, 0.8 mm. long, 0.6 mm. wide. Genital segment, 0.4 mm. long, 0.25 mm. wide.

(*enormis*, irregular, unusual.)

This little *Caligus* is irregular in many respects, such as the extreme reduction of the maxillary hooks in the female and their enormous enlargement in the male; in the almost complete obliteration of the lunules in the female; in the great reduction of the maxillæ in both sexes; in the absence of a furca; in the lack of plumose setæ on the first

Digitized by Google

legs; in the arrangement of the endopod and exopod of the second legs; in the fusion of the endopod of the third legs to the basal plate; in the practical disappearance of the abdomen in the female; and in the peculiar size and shape of the egg-strings.

Taken separately, none of these modifications possesses very much systematic value, but collectively they serve to distinguish the new species from all that have previously been described.

In its general make-up and in its habits it is a typical *Caligus*, and although the species is so small the enlargement of the eggs indicates that the nauplii on hatching are fully the size of those from larger species. This increase in size and consequent ability must compensate in some way for the paucity in the number of eggs.

CALIGUS SUFFUSCUS, new species.

Plate 30, figs. 107–115.

Host and record of specimens.—A couple of females were taken from the mouth of the blue parrot fish, *Scarus cæruleus*, June 30, 1910.

Type-specimen.—Cat. No. 42267, U.S.N.M.

Female.—General body form short and plump; carapace definitely more than half the entire length, one-fourth longer than wide. Frontal plates not prominent; anterior margin nearly straight, with an incision at the center; lunules of medium size and widely separated, just reaching the anterior margin. Eye relatively large and situated far forward; crossbar of the H about in the center of the carapace; lateral areas very narrow, less than one-fourth the width of the thoracic area; lateral lobes obliquely truncated posteriorly; posterior sinuses shallow; median lobe considerably more than half the entire width and projecting far behind the lateral lobes. Free segment one-third the width of the carapace, short and strongly contracted anteriorly and posteriorly. Genital segment one-third the entire length, ovate in outline, squarely truncated posteriorly; corners smoothly rounded and without lobes; fifth legs visible.

Abdomen minute, elliptical, about one-fourth the width and length of the genital segment; anal laminæ widely separated and divergent, each tipped with three long setæ and three short spines on the outer margin. Egg-tubes unknown.

First antennæ short and plump, not reaching the level of the lateral margin; second pair fairly stout, the terminal claw strongly curved, the basal joint reinforced by a long and sharp spine just behind its insertion. Mouth tube short and stout, first maxilla long and slender, reaching well beyond the tip of the mouth tube. Maxilliped with a swollen basal joint and a stout terminal claw, three-quarters as long as the basal joint and strongly curved, with an accessory spine on its inner margin near the center. Furca large

Digitized by Google

and stout, the basal portion nearly rectangular, the rami broad, slightly divergent, of the same length as the basal portion, and bluntly rounded.

First and second swimming legs of the usual pattern; rami of the third pair small and well separated, but rendered prominent by the wide gap between the posterior lobes of the carapace and the genital segment. Fourth legs reaching a little beyond the center of the genital segment, the basal joint as long as the three terminal joints; the latter with five spines, all the same size except the middle terminal one, which is twice the length of the others.

Color yellowish-white, covered on the dorsal surface with sparsely scattered circular spots of brown pigment.

Total length, 2.35 mm. Carapace, 1.25 mm. long, 1.05 mm. wide. Genital segment, 0.75 mm. long, 0.63 mm. wide. Abdomen, 0.2 mm. long, 0.15 mm. wide.

(*suffuscus, sub* and *fuscus*, somewhat brownish or dusky, alluding to the spots on the dorsal surface.)

In its general proportions this species resembles *C. abbreviatus* Krøyer, but the lunules and first antennæ are proportionally much longer, the carapace is not contracted anteriorly, the median lobe projects far behind the lateral lobes, the genital segment is one-fourth longer than wide, instead of one-half wider than long, and the abdomen projects for its entire length behind the genital segment. These characters, together with many differences in the appendages, are sufficient to distinguish the species and establish its validity.

CALIGUS MONACANTHI Krøyer.

Caligus monacanthi KRØYER, 1863, p. 59, pl. 3, fig. 2*a–e*.

Host and record of specimens.—Krøyer obtained a single male, which he referred to this species, from the skin of a *Monacanthus* (probably *M. hispidus*, the file fish) in the West Indies.

The present author has given elsewhere [1] reasons for believing that this was really a young female *C. productus*. It is impossible to be absolutely certain without further material, and so the record is here repeated.

LEPEOPHTHEIRUS COSSYPHI Krøyer.

Lepeophtheirus cossyphi KRØYER, 1863, p. 115, pl. 7, fig. 6*a–e*.

Host and record of specimens.—A single female was taken by Krøyer from the gills of "*Cossyphus bodjanus*" (the Spanish lady fish, *Harpe rufa*) in the West Indies, but this single specimen presents sufficient distinguishing characters to establish the validity of the species.

Two other species of *Lepeophtheirus* have been recorded from fish that are common in the West Indies, and from which they are likely

[1] Proc. U. S. Nat. Mus., vol. 28, p. 607.

Digitized by Google

to be obtained in the future. These are *L. dissimulatus* Wilson, obtained from the red grouper, *Epinephelus morio*, at the Bermuda Islands by Dr. Edwin Linton in 1903,[1] and *L. longispinosus* Wilson, found on the gills of the hammer-head shark at Beaufort, North Carolina, in 1905.[2]

DENTIGRYPS, new genus.

General body form combining the cephalothorax of *Lepeophtheirus*, an entirely concealed fourth segment, the genital segment of *Gloiopotes*, and a peculiar abdomen somewhat like that of *Alebion*. First three thorax segments fused with the head, forming a carapace whose frontal plates, grooves, and areas are just like those of *Caligus* and *Lepeophtheirus*. Fourth and fifth segments fused with the genital segment and the three entirely covered by a single dorsal plate. Attached to the ventral surface of the genital segment, in front of each posterior corner, is a long conical tooth or prong, similar to those on *Gloiopotes*, but destitute of spines or setæ.

Abdomen attached to the ventral surface of the genital segment some distance in front of the posterior margin. Egg-tubes of medium length and like those of *Caligus*. Maxillary hooks and furca both present; first maxillæ simple and undivided and some distance behind the mouth tube. First and fourth legs uniramose, second and third biramose, and all similar to those of *Caligus*.

Type-species.—*D. curtus*, new species.

(*Dentigryps*, *dens*, a prong or tooth, and *gryps*, a griffin.)

The griffin was a fabulous animal, half eagle and half lion, and thus becomes a fitting name for this new genus which unites the typical characters of quite different genera. It has the carapace and all the appendages of *Lepeophtheirus* except the first maxillæ, which here are simple and undivided. But there is no free segment, and the fused fourth, fifth, and genital segments are covered with a plate similar to the carapace, the only thorax joint capable of motion being the one between the third and fourth segments where these two dorsal plates come together. A similar condition prevails in the genus *Homoiotes*.[3]

The ventral prongs or processes on the genital segment are one of the typical characters of the genus *Gloiopotes*, but here they lack the spines and setæ so commonly found in that genus.

The dropping of the abdomen to the ventral surface and its transference forward is typical of the subfamily Pandarinæ, while the posterior lobes on either side of the anal laminæ are characteristic of such genera as *Alebion*.

[1] Proc. U. S. Nat. Mus., vol. 28, p. 631.
[2] Idem, vol. 33, p. 604.
[3] Idem, vol. 28, p. 661.

Digitized by Google

The present genus is thus a sort of patchwork of parts of other genera and may well serve as another connecting link between those genera. The majority of its characters locate it in the Caliginæ.

DENTIGRYPS CURTUS, new species.

Plate 32, figs. 127–135.

Host and record of specimens.—Six females of this new genus were obtained by Dr. Edwin Linton from the mouth and gill cavities of the cardenal or poison grouper, *Mycteroperca venenosa apua*, at the Bermuda Islands, July 27, 1903.

Type-specimen.—Cat. No. 43595, U.S.N.M. Paratypes, Cat. No. 42328, U.S.N.M.

Female.—General body form elliptical, short and wide, apparently truncated through the center of the genital segment and thus presenting a curious sawed-off appearance. Carapace orbicular, as wide as long; dorsal grooving like that in *Caligus*, the crossbars of the H at the longitudinal center; lateral areas very narrow, only one-third as wide as the thoracic area; posterior sinuses rather deep with flaring sides; posterior margin of thoracic area reentrant. Eyes large and placed well forward; frontal plate narrow and without lunules, but with a distinct median sinus.

Fourth thorax segment so thoroughly fused with the fifth and genital segments as to be indistinguishable except by the fourth legs. These three segments are covered with a strongly arched dorsal plate (probably really a fusion of two plates like that in *Homoiotes*), which is fully as wide as the thoracic area of the carapace, half as long as wide, and prolonged at each posterior corner into a short blunt lobe. Just in front of each of these lobes on the lateral margin is a large plumose seta. From the ventral surface of the genital segment in front of the lobes a large conical prong extends backward and outward on either side to a level with the tips of the anal laminæ. These prongs are hard and chitinous, perfectly smooth, and are cut off obliquely at the tips. In one female there was a single long, nonplumose spine near the tip of each prong. Egg-cases wide and about as long as the body; eggs large and similar to those of *Lepeophtheirus dissimulatus*.

On the midline of the ventral surface, between the bases of the prongs, is attached the abdomen. This is one-jointed, somewhat trapezoidal in outline, the same width and length, and just shows its tip behind the dorsal plate of the genital segment. On either side of the anal laminæ the abdomen is prolonged into a short blunt lobe, half the length of the lamina itself. These laminæ are oblong, slightly widened at the tip, and each is armed with three terminal setæ, two on the outer margin and one on the inner.

Digitized by Google

First antennæ short, the tips scarcely reaching beyond the free edge of the carapace; terminal joint slender and considerably longer than the basal. Second antennæ stout, the terminal claw bent abruptly near the tip; maxillary hooks small and not much curved. Mouth tube short and blunt; first maxillæ some distance behind the mouth, long, slender, and undivided; maxilliped with a moderately stout basal joint, and a slender terminal claw, half as long as the basal joint, and with an accessory spine on its inner margin near the center.

First legs with no trace of an endopod and with short setæ on the terminal joint; spines on the exopods of the second legs long and stout; rami of third legs close together, spine on the base of the exopod also long and stout; basal joint of the fourth legs the same length as the three terminal joints, inner terminal seta twice the length of the outer and all three terminal ones toothed.

Color, a yellowish-gray, becoming dark cinnamon-brown in the thicker parts of the body.

Total length, 3.6 mm. Carapace, 2.55 mm. long and wide. Fused fourth, fifth, and genital segments, 0.8 mm. long, 1.6 mm. wide.

(*curtus*, shortened with the idea of being mutilated, the body looking as if some of the posterior part had been cut off.)

Although no specimens of this new genus have yet been obtained from the West Indies, it is almost certain that it will be found there, because its host is even more common there than around Bermuda, and is found as far south as Brazil. There is therefore every reason why it should be included in the present list of parasites.

ANURETES PARVULUS, new species.

Plate 33, figs. 139–147.

Host and record of specimens.—A single female of this interesting species was obtained by Dr. Edwin Linton from the gills of a black angel fish, *Pomacanthus arcuatus*, at the Marine Laboratory of the Carnegie Institution at the Dry Tortugas, Florida, July 15, 1907.

Type-specimen.—Cat. No. 42275, U.S.N.M.

Female.—Cephalothorax ovate, slightly longer than wide, squarely truncated posteriorly; frontal plates well fused with the head, and furnished with a broad, transparent chitinous margin which evidently functions as a sucking disk. The groove at the crossbar of the H visible at the sides only, eliminated at the center; lateral areas narrow; thoracic area half of an ellipse, one-third wider than long, a little more than half the width of the cephalothorax, the posterior margin a straight line connecting the tips of the lateral lobes; posterior sinuses mere notches, scarcely visible.

Fourth (free) segment one-fifth the width of the carapace, considerably thickened through the bases of the fourth legs. Genital segment as wide as long, the same shape as the carapace and half as

Digitized by Google

wide, narrowed to a neck anteriorly where it joins the fourth segment, with the posterior margin slightly convex, without lobes but bearing the rudiments of both the fifth and sixth legs at the rounded posterior corners.

Abdomen fused into the center of the posterior margin of the genital segment, with only the extreme tip visible on either side of the anus; anal laminæ apparently attached to the genital segment, on a level with its dorsal surface; each is large, triangular, and armed with five plumose setæ. Egg-cases attached on either side of the fused abdomen; eggs large and thick, arranged as in *Caligus*.

Joints of the first antennæ equal in length, but the basal one four times as wide as the terminal. Second antennæ slender, a small spine on the posterior margin of the basal joint and an accessory claw on the ventral surface of the terminal claw near its base. Maxillary hooks wholly lacking. First maxillæ reduced to mere semicircular stubs on either side of the mouth tube; second maxillæ like those of *Caligus*. Maxillipeds very large, the basal joint much swollen, the terminal claw as long as the basal joint and bent into a sickle shape, with a small, blunt spine on the inner margin near the base. Mouth tube long and slender, not at all like those of the Caliginæ, but closely resembling those of the Pandarinæ. Swimming legs like those of the Caliginæ; first pair with three terminal claws, three plumose setæ on the posterior margin of the terminal joint, and a rudimentary endopod on the basal joint.

Spines on the exopods of the second legs very long and turned diagonally inward across the succeeding joints. Fourth legs very slender, the basal joint no thicker than the terminal ones.

Color (preserved material), a light gray, the genital segment considerably darker than the carapace.

Total length, 1.2 mm. Carapace, 0.76 mm. long, 0.71 mm. wide. Genital segment, 0.35 mm. long and wide.

(*parvulus*, very small.)

This single specimen is placed in the genus *Anuretes*, but differs in some important particulars from the two species already described. The maxillary hooks are not present; the first maxillæ and furca are reduced to mere stubs, hardly distinguishable; the abdomen is plainly fused into the center of the posterior margin of the genital segment, and the anal laminæ are on a level with the dorsal surface of the genital segment instead of being attached to its ventral surface.

In all other particulars it corresponds with the species described by Krøyer and Bassett-Smith. There can be no question that the present specimen is generically distinct from *Caligus* and *Lepeophtheirus*, and if, in spite of the above differences, it can be referred to the genus *Anuretes*, it will establish the validity of that genus satisfactorily.

Digitized by Google

MIDIAS LOBODES Wilson.

Midias lobodes WILSON, 1911, p. 625, pl. 65, figs. 1–12.

Host and record of specimens.—This species was originally described [1] from specimens obtained by Dr. Edwin Linton at the Dry Tortugas, Florida, from the outside surface of the head of a great barracuda (*Sphyræna barracuda*).

Similar specimens to the number of 40, including both sexes, were obtained from the same host at Montego Bay, Jamaica.

EURYPHORUS CORYPHÆNÆ Krøyer.

Euryphorus coryphænæ KRØYER, 1863, p. 161, pl. 10, figs. 4*a–h*.

Host and record of specimens.—Several specimens were reported by Krøyer from the gills of the common dolphin, *Coryphæna hippurus*, in the tropical Atlantic near the West Indies. This is probably the same species as had been named *nympha* by Steenstrup and Lütken in 1861, which was taken from a "dolphin" near the West Indies.

PARALEBION CURTICAUDIS, new species.

Plate 34.

Host and record of specimens.—Four females were taken from the gills of a 12-pound red snapper, *Neomænis aya*, July 2, 1910.

Type-specimen.—Cat. No. 43601, U.S.N.M. Paratypes, Cat. No. 42271, U.S.N.M.

Female.—General body form short and plump; carapace horseshoe-shaped, one-fourth wider than long, squarely truncated posteriorly; each side of the H grooves has a double curve like the letter S, the part posterior to the crossbar with the concave sides, the anterior part with the convex sides, facing each other; this makes the space between the sides anteriorly only one-fourth what it is behind the crossbar. Posterior lobes wide, their tips curved inward so as to overlap the corners of the median lobe and project slightly behind it; lateral areas very wide anteriorly and narrow posteriorly; posterior sinuses shallow and oval.

Median lobe with projecting corners and a somewhat reentrant posterior margin. Free segment nearly half the length of the carapace, narrowed anteriorly and posteriorly but projecting strongly at the bases of the fourth legs. Genital segment subquadrilateral, as wide as long, three-fifths as wide as the carapace, with short and broad posterior lobes.

Abdomen one-jointed, half the length and one-third the width of the genital segment, with a shallow anal sinus; anal laminæ small and nearly spherical, each tipped with three long setæ and one short

[1] Proc. U. S. Nat. Mus., vol. 39, p. 626.

Digitized by Google

one. Egg-tubes three-fourths as wide as the abdomen, and about half the length of the body.

Joints of the first antennæ equal in length, the terminal one very slender with a few short spines at the tip.

Second antennæ large and stout, the basal joint reenforced by a stout and blunt spine just behind its insertion. Maxillary hook large and stout and strongly curved, with two blunt spines between its base and that of the maxilla; the latter is triangular with a long and slender point without accessory teeth or spines. Maxillipeds comparatively weak, the terminal claw actually smaller than that of the second antennæ. Furca made up of two short, wide, and squarely truncated rami, strongly divergent and each shaped like an hourglass.

Basal joint of first swimming legs with a small spine on the posterior margin near the proximal end, and a very long and slender one at the anterior distal corner. There is also, attached to the posterior margin near the distal end, a rudimentary endopod, which is one-jointed but divided at the tip. The terminal joint of the exopod has three spines at its tip, but no plumose setæ on the posterior margin.

The spines on the exopods of the second and third legs are exceptionally large and stout, that on the third legs being bent into a half circle. Furthermore, both rami of these third legs are distinctly three-jointed, the division of the joints being similar to that on the second legs and totally different from what is found in the Caliginæ. The basal joint of the fourth legs is unarmed and is about as long as the three terminal joints; the spines at the tips of the second and third joints and the three at the tip of the terminal joint are all about equal in size; the second and third of these spines are reenforced at the base by a membrane with a toothed margin. The fifth legs appear on the posterior lobes of the genital segment, outside of the egg-tubes and close to the lateral margin. Each is distinctly two-jointed, and the terminal joint is tipped with three setæ.

The cement glands are club-shaped, the enlarged glandular portion tapering imperceptibly into the narrow duct. On each of the four females obtained there was also a pair of relatively large spermatophores fastened to the lateral margins of the abdomen. Each spermatophore is spherical, two-thirds as wide as the abdomen, and furnished with a very short duct which leads directly inward from the margin to the opening of the sperm receptacle on the midline. These ducts do not cross, but each empties into its own side of the receptacle.

Color a uniform grayish-white without pigment of any sort.

Digitized by Google

Total length, 6 mm. Carapace, 2.65 mm. long, 3 mm. wide. Fourth segment, 1.15 mm. long. Genital segment, 2 mm. long and the same width. Egg-cases, 3.3 mm. long.

(*curticaudis*, *curtus*, short, and *cauda*, tail, in allusion to the very short abdomen.)

The genus *Paralebion* was instituted[1] for some parasites, including both sexes, which were obtained from a shark in Chesapeake Bay. In the type species, *elongatus*, the genital segment has long and pointed posterior lobes, the abdomen is also long and two-jointed, the furca is double, and there are plumose setæ on the terminal joint of the first swimming legs. In the present species the lobes of the genital segment are broad and short, the abdomen is very short, the furca is single, and there are no plumose setæ on the first legs. In other particulars there is a marked similarity between the two species, with just those differences in detail that would naturally be expected.

Family DICHELESTIIDÆ.

LERNANTHROPUS ANGULATUS Krøyer.

Lernanthropus angulatus KRØYER, 1863, p. 196, pl. 9, fig. 1 *a–q*.

Host and record of specimens.—This species was originally described by Krøyer from specimens obtained on the gills of a West Indian *Serranus*, one of the groupers. All the other records are simply copies of this one of Krøyer's, and no other investigator has seen the species. Heller suggests (1865, p. 213) that it is identical with the *Aethon quadratus* previously described by Krøyer. (See p. 192.)

LERNANTHROPUS GIGANTEUS Krøyer.

Plate 33, figs. 148–150; plate 35.

Lernanthropus giganteus KRØYER, 1863, p. 206, pl. 8, fig. 1 *a–e*.—HEIDER, 1879, p. 345, pl. 4, figs. 53 to 55.

Host and record of specimens.—This species was established by Krøyer in 1863 for a single female obtained from the gills of a "*Caranx carangus*" taken in Brazil and sent first to the Vienna Museum and thence to the Royal Museum at Copenhagen. This same specimen was afterward examined and described by Heider (1879). "Many specimens" were reported by Bassett-Smith (1898, p. 360) from the gills of "*Caranx melamphigus*" at Aden in the Indo-Tropics. In the present instance two lots were obtained, each of which included both sexes; the first from the gills of *Caranx crysos* is included under Cat. No. 42277, U.S.N.M.; the second from the gills of *Caranx hippos*, under Cat. No. 42282, U.S.N.M.

Female.—General body form short and rather plump; cephalothorax ovoid, its posterior corners well rounded, with the sides of the carapace projecting considerably in front of the anterior margin.

[1] Proc. U. S. Nat. Mus., vol. 39, p. 628.

Digitized by Google

Antennal segment small, triangular in shape, and just fitting into the sinus between the projecting sides of the carapace. Second and third segments in the free thorax covered with a dorsal plate trapezoidal in outline, narrowed anteriorly and widened posteriorly, with a short triangular process extending outwards and backwards from each posterior corner opposite the bases of the third legs. Fourth segment with a dorsal plate which is considerably wider than the one just mentioned, and which extends back well beyond the tips of the anal laminæ. In shape it is about three-quarters of an ellipse, the straight edge being separated from the posterior margin of the preceding plate by a well defined groove, and the remainder of the margin being evenly curved, with no posterior sinus. Fifth segment very short and narrow, and having a pair of uniramose fifth legs, which are linear, curved like parenthesis marks, and do not quite reach the posterior margin of the dorsal plate of the fourth segment. Genital segment also short and narrow, bearing on its sides the egg-tubes, and at the posterior corners the large secondary spermatophores.

Abdomen minute, one-jointed, almost completely fused with the genital segment; anal laminæ linear, as long as the entire abdomen, and destitute of setæ or spines. Egg-tubes narrow, and two and a half times the length of the body; eggs thin, numerous, and arranged occasionally in more than a single row. (See fig. 150.)

First antennæ six-jointed and very short; the second pair some distance behind the first, and curved over ventrally between the sides of the carapace so as to be invisible in dorsal view. At their base, where they join the front of the head, they are supported by a stout and complicated chitin framework. The mouth tube and mouth parts are carried back so far behind the antennæ that they appear to belong to the thorax rather than the head. Mandibles of the usual pattern; first maxillæ stout, the basal joint swollen, the terminal joint tipped with a straight and stout spine. Second maxillæ simple, the terminal claw stout, nearly straight, and two-thirds as long as the basal joint. Basal joint of maxillipeds much swollen, terminal claw slender, slightly curved, and half the length of the basal joint.

Endopods of first and second legs tipped with a single long and straight spine; exopod of first pair with five terminal saw teeth, exopod of second pair with four. Inside of the endopod of the first legs is a small papilla tipped with a spine.

The third legs are shaped like those of *L. gisleri*, *krøyeri*, *pagodus*, etc., and are distinctly bilobed, one lobe extending backward, the other outward at right angles to the body axis. The rami of the fourth legs are narrow and acuminate and reach for nearly their whole length behind the dorsal plate of the fourth segment. The more or less irregular arrangement of the eggs and the attachment of the spermatophores (fig. 149) are worthy of especial notice.

Digitized by Google

Total length, 8 to 9 mm. Cephalothorax, 2 mm. long, 1.6 mm. wide. Thorax, 5 mm. long, 3.6 mm. wide. Egg-strings, 18 to 20 mm. long.

Male.—General body shape elongate and narrow; cephalothorax ovate, with a squarely truncated frontal margin. Antennal area separated from the rest of the head by a well-defined groove as in the female. Posterior body spindle-shaped, the same width as the cephalothorax, but half as long again, with the free thorax, genital segment and abdomen thoroughly fused.

First antennæ relatively much longer than in the female and projecting prominently from the anterior corners of the cephalothorax. Second pair very stout, the basal joint swollen, supported on a complex chitin framework, and armed on the inner margin near the proximal end with a short tooth. Mouth parts as in the female, the basal joint of the maxilliped being considerably stouter. First legs with minute one-jointed rami, the endopod with one spine longer than the ramus itself, and a second much shorter one, the exopod with four short saw teeth.

Endopod of second legs tipped with a single large spine the same length as the ramus; exopod enlarged toward the tip, where it carries two minute spines interspersed with a row of short hairs. Third legs with a short basal portion, an exopod two-thirds as long as the entire body, and an endopod reduced to a mere knob on the inner margin of the basal portion at its tip.

Fourth legs as long as the entire body, basal portion projecting well beyond the lateral margins; rami about the same size and length.

Total length, not including the legs, 2.75 mm.; including the legs, 4 mm. Cephalothorax, 0.95 mm. long, 0.75 mm. wide. Posterior body, 0.75 mm. wide, 1.8 mm. long. Fourth legs, 2.5 mm. long.

Color of both sexes, a dark yellowish-gray, without pigment markings of any sort.

(*giganteus*, of large size.)

Hitherto there have been but two descriptions of this species, both made from the same (single) female; to these is now added the present description and drawings from an abundance of living material, taken on new hosts and in a different locality and including for the first time the male sex. We thus get acquainted with the variations in size and structure and the relative proportions of the male.

The species is readily distinguished by its size, by the narrow cephalothorax with its sides projecting in front of the anterior margin, by the short projections of the dorsal shield opposite the bases of the third legs, by the very long and narrow fourth legs, which reach far behind the dorsal shield of the fourth segment, and by the thread-like fifth legs, curved like parenthesis marks. The species is still among the largest in the genus and is one of the few instances where the original "giant" has retained its prestige.

Digitized by Google

LERNANTHROPUS FRONDEUS, new species.

Plate 36.

Host and record of specimens.—Ten specimens, containing both sexes, were obtained from the gills of the red snapper, *Neomænis aya*, on July 16, 1910.

Type-specimen.—A female, Cat. No. 43520, U.S.N.M. Paratypes, Cat. No. 42287, U.S.N.M.

Female.—General body form elongate, narrowed anteriorly and widened posteriorly; cephalothorax ovate, less than one-third the length of the body exclusive of the legs, and about the same width as the second and third thorax segments. Carapace projecting neither along the lateral margins nor in front, leaving the first and second antennæ entirely visible in dorsal view. Second and third thorax segments separated by a distinct groove, the former short with strongly convex margins, the latter twice as long with nearly straight margins. Dorsal plate of the fourth segment broadly kidney-shaped, nearly twice the width of the third segment, with a very evenly curved outline. Fifth and genital segments and abdomen so short as to be considerably wider than long, but well defined and separated from one another by grooves. Anal laminæ much enlarged and foliaceous, each being half as wide again, and more than five times as long, as the abdomen. Egg-strings narrow and tapering posteriorly, nearly twice as long as the body; eggs thin and numerous.

First antennæ small but prominent, seven-jointed; antennal area wide and separated from the rest of the head by a well-defined groove; second antennæ stout, the basal joint considerably longer than the terminal claw, and carrying on its inner margin near the center a small papilla tipped with a hair-like spine. First maxillæ stout, the terminal joint as thickset as the basal and tipped with three spines, the central one of which is longer than the other two. Second maxillæ with a slender terminal claw, the same length as the swollen basal joint and slightly enlarged at the tip. Basal joint of maxillipeds much swollen, terminal claw conical and shorter than the basal joint. Exopods of first two pairs of legs wider than the conical endopods and considerably flattened; first exopod armed with five short and stout spines; second exopod with three spines and two short teeth on the outer margin. Each endopod carries a single long and stout spine.

Third legs uniramose, each shaped like an ovate leaf with an acuminate tip; each leg is three-fourths as wide as the third segment itself, and as they do not overlap on the midline it follows that they project from the lateral margins of the third segment even beyond the level of the dorsal plate on the fourth segment. Fifth legs also

Digitized by Google

shaped like an ovate acute leaf, each actually wider than the fifth segment and reaching well beyond the posterior margin of the dorsal plate of the fourth segment. Fourth legs biramose, each ramus broad and leaf-like at the base and tapering into a long and acuminate tip, which shows for nearly its entire length beyond the posterior margin of the dorsal plate of the fourth segment.

Total length, without legs, 8 mm.; with fourth legs, 11.5 mm. Cephalothorax, 3 mm. long, 1.9 mm. wide. Dorsal plate on fourth segment, 3.2 mm. wide, 2.5 mm. long.

Male.—General body form oblong, the same width throughout, three times as long as wide. Cephalothorax ovate, three-sevenths of the entire length; antennal area distinctly separated and much narrower than the remainder of the cephalothorax. Free thorax, genital segment, and abdomen well fused, without transverse grooves, but with marginal invaginations indicating the segmentation. Genital segment considerably narrower than the free thorax; anal laminæ elongate and flattened, but not as foliaceous as in the female. Appendages similar to those of the female, the terminal claws of the second maxillæ and maxillipeds longer and sharper. Third and fourth legs biramose, slender, and thread-like; endopod of third pair rudimentary and very short; endopod of fourth pair much shorter than the exopod, which latter is nearly as long as the entire body; fifth legs wanting.

Color of both sexes a creamy yellow, without pigment markings.

Total length, without fourth legs, 3.5 mm.; with fourth legs, 5.5 mm. Cephalothorax, 1.5 mm. long, 1 mm. wide. Posterior body, 2 mm. long, 0.9 mm. wide.

(*frondeus*, covered with leaves, in allusion to the shape of the third, fourth, and fifth legs and the anal laminæ in the female.)

Nauplius larva.—Body shield-shaped, with square anterior corners and a pointed posterior margin. Eye very far forward, just behind the anterior margin. Appendages of the usual pattern, the three pairs of about the same length. Balancers far back on either side of the posterior point, curved outward and forward, rather short and stout. Center of the body filled with a dark mass of cinnamon-brown pigment, leaving only a narrow margin clear. This mass of pigment makes the egg-strings of the adult female very dark brown just before they are ready to hatch.

This species can be readily distinguished by the broad and foliaceous legs and anal laminæ of the female, and by the fact that the cephalothorax and free segments of both sexes are about the same width. The two pairs of antennæ are also peculiarly prominent in dorsal view. It is one of the larger species, and gives an excellent typical idea of the genus which it represents.

Digitized by Google

LERNANTHROPUS OBSCURUS, new species.

Plate 37.

Host and record of specimens.—Both sexes of this species were taken from the gills of the yellow tail, *Ocyurus chrysurus*, July 23, 1910.

Type-specimen.—A female, Cat. No. 43600, U.S.N.M. Paratypes, Cat. No. 42332, U.S.N.M.

Female.—General body form short and fairly plump; cephalothorax elliptical, a little longer than wide; antennal area well defined, second antennæ not visible in dorsal view; second and third thorax segments about the same length and width as the cephalothorax, with a shallow lateral sinus between them; sinus between the third and fourth segments narrow and deep; dorsal plate of fourth segment as long as the cephalothorax and half as wide again, with a deep sinus in the center of the posterior margin; fifth and genital segments and abdomen diminishing regularly in length and width; anal laminæ broad and foliaceous and as long as the three preceding segments combined.

First antennæ of the usual pattern and rather plump, very indistinctly segmented toward the base. Second antennæ with swollen basal joints, destitute of any tooth on the inner margin, and a short, rather slender, and strongly curved terminal claw. First maxillæ with a long terminal joint, tipped with two short and equal spines. Basal joints of second maxillæ and maxillipeds much swollen; terminal claws slender, but nearly as long as the basal joints. Rami of first two pairs of legs of the usual pattern, but stouter than in most species. Third legs uniramose, longer than the second and third segments together, and somewhat widened and flattened at the base so as to be semifoliaceous. Fourth legs biramose, rami elongate-conical, exopods slightly longer than the endopods, and both projecting for nearly their entire length behind the dorsal plate of the fourth segment. Fifth legs narrow foliaceous, well flattened, and just reaching the posterior margin of this same dorsal plate.

Total length, 6.5 mm., with the fourth legs; 4.35 mm. without them. Cephalothorax, 1.5 mm. long, 1.35 mm. wide. Second and third segments, 1.5 mm. long, 1.25 mm. wide. Dorsal plate of fourth segment, 1.5 mm. long, 1.9 mm. wide.

Male.—General body form spindle-shaped; cephalothorax ovate, nearly half the entire length of the body proper; antennal area considerably narrowed and separated by a well-defined groove; posterior body without transverse grooves, but with the segmentation indicated by marginal sinuses, widest through the third segment and thence tapering rapidly backwards; anal laminæ linear, divergent, each tipped with two minute spines.

Appendages like those of the female, with a few exceptions.

Digitized by Google

The outer terminal spine of the first maxillæ is much shorter than the inner one; the terminal claws of the second maxillæ and maxillipeds are relatively shorter; the rami of the first and second legs are less plump; the third and fourth legs are both uniramose, and the rami are narrow-cylindrical.

Color of both sexes a light yellowish-white, without pigment.

Total length, with fourth legs, 3 mm.; without them, 2 mm. Cephalothorax, 1 mm. long, 0.66 mm. wide. Posterior body, 1 mm. long, 0.66 mm. wide.

(*obscurus*, obscure or hidden, in the sense that the species does not possess any very marked characters.)

This species has to be recognized by an aggregation of characters rather than by any one or two. The narrow second and third thorax segments, the deep sinus between the third and fourth segments, the uniramose third legs and the very long fourth legs, make a combination found in no other species.

It is not at all common, being found on but a single fish during the entire season.

LERNANTHROPUS SPICULATUS, new species.

Plate 38, figs. 185–189.

Host and record of specimens.—A single lot, consisting of three females, was obtained from the gills of the lane snapper, *Neomænis synagris*, July 15, 1910.

Type-specimen.—Cat. No. 43598, U.S.N.M. Paratypes, Cat. No. 42279, U.S.N.M.

Female.—General body form oblong, four times as long as wide; cephalothorax ovate, the lateral margins projecting anteriorly in the form of a short knob or horn on either side. A distinct notch in each margin indicates the separation of the antennal area from the rest of the head, but there is no transverse groove. Fused second and third segments subquadrilateral, with parallel sides and nearly square corners, the separation of the two segments being faintly indicated by marginal notches. Dorsal plate of the fourth segment obovate, the posterior margin slightly reentrant at the center. Third legs entirely concealed in dorsal view; both rami of the fourth pair projecting far behind the dorsal plate. Fifth segment short and destitute of appendages; genital segment also short and narrow.

Abdomen subquadrilateral, the same length and width; anal laminæ as long as the genital segment and abdomen, stout, with their tips curved away from each other. But in spite of their length they only reach halfway to the posterior margin of the fourth dorsal plate, and hence this extreme posterior portion of the body is entirely concealed in both dorsal and ventral views.

None of the females captured carried egg-strings and so these are unknown.

Digitized by Google

First antennæ small, very rudimentary, and entirely destitute of setæ or spines; they are also concealed between folds of the carapace so as to be invisible. Second pair of good size, the basal joint much swollen, the terminal claw stout and strongly curved. First maxilla with a large terminal joint tipped with two spines; second maxilla with a moderately swollen basal joint, and a long and weakly curved claw. Maxillipeds with a very stout basal joint and a short terminal claw, bent abruptly near the base, but for the rest of its length almost straight.

First legs rudimentary, without spines or setæ and well concealed beneath the maxillipeds; the second pair are reduced to mere knobs on the ventral surface of two prominent ridges running parallel with the body axis, one on either side of the midline and quite close to it. The third legs are of the usual plicate form, separated to their base along the midline, and leaving concave grooves externally and internally, but with the anterior margin a straight line. These legs reach only a trifle beyond the posterior margin of the third segment. The fourth legs are biramose; each ramus is enlarged at the base and then rapidly tapers to a long, cylindrical and bluntly pointed tip; the two legs almost touch along the midline and entirely conceal the fifth and genital segments and the abdomen.

Color a yellowish-gray, without pigment markings of any sort.

Total length 6.12 mm. with the fourth legs, 4.75 mm. without them. Cephalothorax 1.35 mm. long, 1 mm. wide. Second and third segments 1.35 mm. long, 1.70 mm. wide. Fourth dorsal plate 2.2 mm long, 1.62 mm. wide.

(*spiculatus*, furnished with spines or points, alluding to the pointed tips of the fourth legs.)

This species may be recognized by the long and sharp-pointed rami of the fourth legs, which project very prominently behind the fourth dorsal plate, by the entire concealment, in both dorsal and ventral views, of the fifth and genital segments and abdomen, by the very rudimentary form of the second legs and antennæ, and by the size and shape of the anal laminæ.

SAGUM, new genus.

General body form similar to that of *Lernanthropus*. Cephalothorax irregular in outline, the antennal area being separated from the head by deep marginal sinuses, forming a sort of beak or rostrum, and the carapace being produced into a broad, irregular wing on each lateral margin. Posterior body covered with a single dorsal plate, which is prolonged at the posterior corners of the third segment into very large lobes, and is continuous through the center of the body with the dorsal plate of the fourth segment. Antennæ and mouth parts similar to those in *Lernanthropus;* each of the first and second

Digitized by Google

legs reduced to a simple one-jointed process, bipartite at the tip; third legs with a broad and laminate endopod reaching back beyond the tips of the fourth legs and covering them ventrally; rami of fourth legs laminate at the base, flagellate at the tip. Fifth and genital segments and abdomen reduced and concealed as in *Lernanthropus;* anal laminæ short, turned over ventrally and enlarged into four blunt lobes at the tip. Egg-tubes unknown.

Type-species.—Sagum flagellatum.

(*Sagum*, a military cloak, alluding to the shape of the fused dorsal plates covering the thorax.)

SAGUM FLAGELLATUM, new species.

Plate 39.

Host and record of specimens.—Two females of this new genus and species, both lacking the egg-strings, were obtained from the gills of the rock hind, *Epinephelus adscensionis*, August 9, 1910.

Type-specimen.—Cat. No. 42280, U.S.N.M.

Female.—General body form short and stout, the division into body regions very indistinct. Cephalothorax short, a little more than one-fourth of the entire length and one-fifth wider than long; deeply notched on either side just back of the antennal area, the portion between the notches forming a broad rostrum one-third as long as the rest of the cephalothorax. This is a condition very similar to that found in the genus *Abasia.*[1] The carapace is prolonged forward on either side of this rostrum as a short process or wing, and outward on either lateral margin as a large triangular wing.

These wings, in addition to the rostrum, give the cephalothorax a very irregular outline. The second, third, and fourth segments are so thoroughly fused that there is no indication of any joints, and they are covered with a single, continuous dorsal plate. On either side of the cephalothorax the second segment projects forward in a broad, rounded knob, like a pair of shoulders. The posterior corners of the third segment are similarly prolonged backward and outward like the skirts of a long military cloak. The part corresponding to the fourth dorsal plate in *Lernanthropus* is as wide as both these posterior skirts together, and about the same length as the rami of the third and fourth legs. The fifth and genital segments and abdomen are entirely concealed between the third and fourth legs and the dorsal carapace. The fifth segment is rather long and narrow and destitute of appendages; the genital segment is transversely elliptical and a little shorter than the fifth segment.

The abdomen is half the width of the genital segment; the anal laminæ extend outward ventrally at right angles to the body axis and are enlarged at the tips into an irregular four-lobed mass; the

[1] See Proc. U. S. Nat. Mus., vol. 33, p. 612.

Digitized by Google

laminæ are so short that these masses seem to rest directly upon the ventral surface of the abdomen.

First antennæ six-jointed, slender, and well armed with setæ; second pair stout, with swollen basal joints and short and stout terminal claws. First maxillæ simple, two-jointed, and tipped with a single short and stout spine; second maxillæ and maxillipeds with short and rather weak terminal claws, and moderately swollen basal joints.

First and second legs very rudimentary, each leg consisting of a one-jointed process divided at the tip. In the first legs these processes are short and broad, but in the second legs they are narrow and acuminate. The third and fourth legs are peculiar and quite different from anything thus far found in *Lernanthropus*. The third pair on the outside pass insensibly into the posterior skirts of the third segment; in the center is a short plicate portion, and on the inside is a long and flattened endopod, pointed at the tip, which reaches back beyond the fourth legs to the posterior border of the fourth dorsal plate. These legs therefore cover and conceal the fourth pair, a condition never found in *Lernanthropus*. The fourth legs are made up of a narrow endopod and a much wider exopod, each strongly flattened and enlarged into the shape of a spatula, and furnished with a narrow tip like a whiplash, attached to the end of the endopod and to the inner margin of the exopod. The function of these flagellate portions is difficult to surmise.

Color a uniform yellowish-gray without pigment markings.

Total length, 5.75 mm. Cephalothorax, 1.45 mm. long, 1.85 mm. wide. Second thorax segment, 2.95 mm. wide. Third segment, 4 mm. wide.

(*flagellatum*, furnished with flagella or whiplashes, alluding to the fourth legs.)

This genus may be readily distinguished from *Lernanthropus* by the rostrum and wings of the cephalothorax, by the long endopods of the third legs, and by the lash-like tips of the fourth legs. They are not at all common, this one lot being all that were found for the entire season.

NEMESIS VERSICOLOR, new species.

Plate 38, figs. 190–194; plate 40.

Host and record of specimens.—A single lot of six specimens, including both sexes, was obtained from the gills of the hammer-head shark, *Sphyrna zygæna*, June 17, 1910. The females were found on the tips of the gill filaments, indiscriminately arranged, while the males were attached to the inner surface of the filaments some distance from the tips.

Type-specimen.—A female, Cat. No. 43602, U.S.N.M. Paratypes, Cat. No. 42294, U.S.N.M.

Digitized by Google

Female.—General body form oval, two and one-half times as long as wide, narrowed a little anteriorly and much more posteriorly.

Cephalothorax covered by a carapace which is slightly longer than wide and only two-thirds of the width of the second segment, with a knob on each lateral margin just in front of the center. Second, third, and fourth segments each covered with a semicircular carapace which extends around the sides of the body to the ventral surface, the three carapaces all about the same size. Fifth segment narrowed to half the width of the fourth and covered on the dorsal surface only with a carapace, which is transversely elliptical and does not reach the posterior margin of the segment. Genital segment one-third narrower than the fifth segment, nearly twice as wide as long, with the egg-strings attached close to the lateral margins.

Abdomen less than half the width of the genital segment and about the same length, made up of three joints, the terminal of which is as long as the two basal together. Anal laminæ oval in outline, two-thirds as long as the entire abdomen, each tipped with four short spines.

Egg-cases the same width as the abdomen, and from one to one and two-thirds times the length of the body; eggs large, from 25 to 40 in each case.

First antennæ slender and many-jointed, tapering gradually to the tip, and attached to the anterior margin of the head close to the dorsal surface. Second antennæ four-jointed, the terminal joint a long sickle-shaped claw; the third and fourth joints project nearly their length in front of the anterior margin of the head, and form important accessory attachment organs.

The second maxillæ are two-jointed, the joints about the same length, the terminal one with two projections at the tip on the anterior margin, each elliptical in outline, and about as long as the terminal joint is wide. Maxillipeds very large and sickle-shaped, projecting their entire length beyond the margin of the carapace, two-jointed, the terminal joint a claw which is slightly shorter than the basal joint. The tip of this claw is stained a deep red as though with blood.

The first pair of legs is considerably modified in form; the basal joint of the exopod is curved inward, narrowed at the base and enlarged at the tip into a broad spatula, with the tiny terminal joint attached to the center of the terminal margin. The endopod is made up of three parts; the outer of these is very narrow, longer than the others, sickle-shaped, and curves outward over the basal joint of the exopod, with a row of long cylindrical teeth along the concave and convex margins; the other two parts are shorter and stouter and are covered with short spines. The second, third, and fourth legs are biramose, the rami are two-jointed, and the terminal

Digitized by Google

joint is considerably narrower than the basal. The exopod of each pair is attached to the outer margin of the basal joint, the endopod to the posterior margin. The basal joint of each ramus carries a stout spine on either side of the terminal joint; the latter carry six spines except in the endopods of the third and fourth legs, where they have only four.

Color a lemon-yellow, inclined to orange on the dorsal surface, the tips of the maxillipeds a dark blood-red, the digestive tube a deep blue-black. Egg-strings sulphur-yellow, turning pink with development.

Total length, 3.1 mm. Carapace, 0.8 mm. long, 0.75 mm. wide. Second thorax segment, 1.15 mm. wide. Egg-strings, 3 to 5 mm. long.

Male.—Body narrow and elongated, about the same diameter throughout the thorax, the abdomen only one-third as wide. Carapace oblong, one-third longer than wide, with nearly straight anterior and posterior margins. First thorax segment partially separated from the head; second, third, and fourth segments increasing much in length and slightly in width. Fifth segment one-third the length of the fourth segment; genital segment the same length as the fifth segment but not as wide; abdomen two-jointed, joints the same length; anal laminæ narrow and elongate, each tipped with three short spines.

First antennæ stouter than in the female, the basal joints much larger than the terminal; second pair comparatively small and slender, the terminal claw very weak. First maxillæ with a rudimentary endopod and exopod, each one-jointed and tipped with two spines; second pair with a large claw arising from the anterior margin at the tip of the terminal joint, and curving around the end so as to point backward.

Maxillipeds modified into huge chelæ, the dorsal jaw stout and bluntly rounded at the tip, the ventral jaw a slender pointed claw, its tip curved around the end of the dorsal jaw, and with a fringe of short hairs along the posterior margin.

First four pairs of legs biramose; the first pair very rudimentary, both rami one-jointed and tipped with two short spines; exopods of second, third, and fourth pairs attached to the outer margin of the basal joint as in the female; exopod of second pair four times the length of the endopod and two-jointed, the terminal joint tipped with four spines; endopod minute, one-jointed, with three spines; rami of third pair about the same length, exopod three-jointed with five spines, endopod two-jointed with a single terminal spine; endopod of fourth pair longer than the exopod, two-jointed, with a single terminal spine much longer than the ramus itself; exopod three-jointed with five spines; fifth legs stout, but one-jointed, with a single tiny spine near the tip.

Digitized by Google

Color similar to that of the female.

Total length, 1.70 mm. Carapace, 0.66 mm. long, 0.25 mm. wide. Fourth thorax segment, 0.5 mm. long, 0.3 mm. wide.

(*versicolor*, variegated in color.)

This West Indian species is quite different from the one found upon the sharp-nosed shark, *Scoliodon terræ-novæ*, farther north, off the coast of Georgia and the Carolinas.

If we contrast the females we notice first that the cephalothorax is relatively larger in the northern form, and has evenly curved margins, without any projections. But there is a tooth on each lateral margin of the second segment, a shallow sinus in each lateral margin of the fourth segment, and the dorsal plate of the fifth segment is three-lobed posteriorly, none of which conditions are found in the southern species. The fifth and genital segments and the abdomen are also relatively much larger in the northern form; there are minor differences in the antennæ, mouth parts, and swimming legs.

When we compare the males we find far greater distinctions. In the northern form the body is about the same width throughout; the carapace is a regular ellipse, one-third of the entire length, and wider than any of the following segments; the second, third, and fourth segments diminish regularly in width and length; the maxillipeds have simple and regular claws. In the West Indian species, on the contrary, the carapace is oblong, with nearly straight sides, is less than one-fifth the entire length, and is considerably narrower than the fourth segment; the second, third, and fourth segments increase considerably in length and width; the maxillipeds form a well defined chela instead of a simple claw.

HATSCHEKIA ALBIRUBRA, new species.

Plate 41, figs. 209–215.

Host and record of specimens.—Four females of this new form, all without the egg strings, were taken from the gills of the lane snapper, *Neomænis synagris*, July 16, 1910. They are made paratypes and have been given Cat. No. 42288, U.S.N.M.

Another lot, also of four females without egg strings, was obtained from the gills of the yellowtail, *Ocyurus chrysurus*, on August 4.

Type-specimen.—Cat. No. 43591, U.S.N.M. Paratypes Cat. No. 42309, U.S.N.M., both from the yellow-tail.

Female.—General body form elongate, three and one-half times as long as wide; carapace small, only one-eighth the entire length and much narrower than the thorax, transversely elliptical, one-third wider than long, with an evenly curved outline.

Fused frontal plates projecting from the frontal margin; dorsal median carina well defined and divided into a Y anteriorly. Fused

Digitized by Google

thorax elongate, club-shaped, the wide end anterior, with nearly straight lateral margins, which converge posteriorly, the segmentation being clearly indicated by marginal indentations. The two leg-bearing segments are the same width as the carapace, but much narrower than the third segment, thus forming a short and wide neck. Third segment rather abruptly widened to one and three-quarters times the diameter of the first two segments, and then, with the fourth and fifth segments tapering regularly backward to the base of the sixth segment, without any posterior lobes. Sixth segment and abdomen semicircular, one-third the diameter of the fifth segment; anal laminæ narrow oblong, each tipped with two minute spines.

Egg-strings of medium width and half as long as the body; eggs large, eight or nine in each string.

First antennæ closely appressed to the frontal margin of the carapace and scarcely reaching its lateral margin, with setæ on the two terminal joints only. Terminal claw of the second antennæ slender, three-quarters as long as the stout triangular basal joint, abruptly bent at a right angle near its base, with the free end strongly curved inward. Maxillæ present as minute papillæ beside the mouth tube, each tipped with three tiny spines. The two terminal joints of the maxilliped are considerably longer than the moderately stout basal joint; the terminal claw has an accessory spine on its inner margin near the tip. The swimming legs have stout basal joints and wide rami; the first exopod is tipped with four spines, the second with three, and each endopod with five; there is a long and stout spine on the basal joint of the first legs, inside of the endopod, and a much smaller one in a similar position on the second legs.

Color a light lemon-yellow, the lacunæ filled with bright red blood; these lacunæ are thickest along the lateral margins, giving them a bright orange color, with an irregular red line through it; this red line widens at the anterior and posterior ends of the oviducts. The muscles of the head and the first two thorax segments are also bright red; the oviducts and freshly extruded eggs are snow-white.

Total length, 1.75 mm. Carapace, 0.32 mm. wide, 0.25 mm. long. Fused thorax, 1.42 mm. long; third segment, 0.5 mm. wide.

(*albirubra*, *albus*, white, and *ruber*, red.)

This species most resembles *H. oblonga* (see p. 242) from the red snapper, but it may be easily distinguished by the fact that the carapace is much narrower than the fused thorax, while the latter is much wider anteriorly than posteriorly. Again, the rich pink-red color of the present species and the snow-white ovaries and oviducts form a striking contrast not known to occur in any other species, and finally the stout basal joint of the second antennæ is very different from the long and slender basal joint in *oblonga*.

Digitized by Google

In connection with this species the author had an unusual and very interesting experience. When first obtained none of the females had any portion of their egg-strings, but two of them extruded their eggs while being examined under the microscope.

The conditions were artificial, to be sure, and yet the method was suggestive and well worth recording. The two females writhed convulsively for some time, contracting the longitudinal body muscles with especial violence. So vigorous were these convulsions that at first it was supposed some chemical had gotten into the sea water in the watch glass, but this was afterwards conclusively disproved. The cement glands were the first to respond, and they poured out enough of their secretion to form a pair of empty cases the full length of the completed egg-strings. These were narrow, hollow, elastic, and tapered to a sharp point at their tips. Into these the eggs were forced, one at a time, each egg requiring severe contraction to force it through the external opening of the oviduct. As it issued into the external case it distended the latter considerably, thereby proving it to be elastic. The first egg remained close to the genital segment until it was pushed along by the extrusion of the second one, and this by the third, and so on. The tip of the case remained all the while much narrower than the part filled by the eggs, and was sharply pointed until finally the first egg was pushed back into it and rounded it out into its usual form.

So far as known the extrusion of the egg cases has never before been witnessed among the Dichelestiidæ, and from it we may deduce the following:

1. The cement substance which forms the external case is not extruded piecemeal along with each egg, but the full amount necessary to form the case is pushed out before any egg is laid, and has a chance to stiffen somewhat in contact with the sea water before the first egg enters it.

2. The bag thus formed previous to the issuance of the eggs is not smooth; each muscular contraction seems to push out a certain amount of the substance, approximately enough to cover one egg, and between these successive portions the bag is slightly constricted, making it appear segmented.

3. The bag is but little more than half the diameter of the eggs and tapers to a sharp point at its tip; hence it must stretch as the eggs are pushed into it. At first it appears to be quite elastic, but loses this quality with every successive stretching and soon remains distended so that the eggs slip along through it easily.

4. Each egg remains close to the body until pushed backward by the issuance of the next one, the tip of the bag hanging loosely like the finger of a glove that is being put on for the first time.

Digitized by Google

5. Under such conditions the number of eggs in any given string is determined at the beginning by the size of the original case.

This is very different from what is found in the Caligidæ, where there are partitions between the individual eggs, or in the Ergasilidæ, where the eggs ripen individually or in small groups.

Probably each method of extrusion is more or less characteristic of the family represented.

HATSCHEKIA OBLONGA, new species.

Plate 42, figs. 222–226.

Host and record of specimens.—Ten specimens of this species were obtained from the gills of the red snapper, *Neomænis aya*, all females, three of which carried egg-strings. They were fastened between the gill filaments, the head usually on the inner surface of the filament, and the body at right angles to it. While fairly common they were not at all numerous.

Type-specimen.—Cat. No. 43554, U.S.N.M. Paratypes, Cat. No. 42319, U.S.N.M.

Female.—General body form oblong, four and one-half times as long as wide; carapace small, one-fifth of the entire length, transversely elliptical, one-third wider than long, with very evenly curved margins. Fused frontal plates also transversely elliptical and projecting their entire length from the frontal margin. Dorsal median carina of the carapace well developed. Fused thorax segments cigar-shaped, tapering posteriorly; first and second segments forming a neck, one-third narrower than the third segment and connecting the latter with the carapace. Third, fourth, and fifth segments indistinguishably fused, with neither marginal indentations nor grooves; fifth segment ending in a blunt lobe on either side of the sixth segment. The latter and the abdomen semicircular, two-fifths the width of the fifth segment; anal laminæ narrow-oblong, each tipped with two minute spines.

Egg-strings half the length of the body, considerably wider than the genital segment, curved like parenthesis marks, and each containing about 15 eggs.

First antennæ closely appressed to the anterior margin of the carapace and scarcely reaching its lateral margin. Second pair with a terminal claw half the length of the slender basal joint, and bent sharply at a right angle close to its base. The slender second and third joints of the maxillipeds are together about the same length as the much stouter basal joint. Each of the swimming legs has a short and wide basal joint, a slender two-jointed exopod tipped with two spines, and a stout one-jointed endopod tipped with a single stout spine; each basal joint carries a small papilla, tipped with a stout spine, just inside the base of the endopod. The cement

Digitized by Google

glands are long and slender, the glandular portion one-third of their entire length. Color similar to that of *H. linearis* from the red-mouthed grunt. (See p. 247.) Head yellowish with a faint tinge of brown, more noticeable on the chitin ribs and the thicker portions of the integument; free thorax and genital segment with yellow margins tinged with olive-green; inside of these the long oviducts are yellowish anteriorly, then become light brown and eventually dark cinnamon-brown posteriorly; the central line over the intestine yellowish with orange margins; egg-strings dark cinnamon-brown. There are none of the dark red streaks through the head and free thorax so prominent in *linearis*.

Total length, 1.70 mm. Carapace, 0.36 mm. wide, 0.27 mm. long. Fused thorax, 1.27 mm. long, 0.36 mm. wide. Egg-strings, 0.82 mm. long, 0.145 mm. wide.

(*oblongus*, oblong.)

This species may be distinguished by its oblong form, its small elliptical carapace of the same width as the fused thorax, by the narrowing of the first two thorax segments, and by the short curved egg-strings. It is fairly common on the red snapper, but only one or two specimens are found on a fish.

HATSCHEKIA UNCATA, new species.

Plate 43.

Host and record of specimens.—A dozen females, nearly all with egg-strings, were obtained from the gills of the rock hind, *Epinephelus adscensionis*, July 12, 1910. They were fastened to the gill filaments, close to the base of the latter, and in the space between two adjacent filaments, in such a way that their bodies were entirely concealed, and only the egg-strings were visible. The body axis was at right angles to the length of the filament, thus bringing the egg-strings parallel with the latter, and just flush with its outer surface. The dozen specimens were obtained from half as many fish.

Type-specimen.—Cat. No. 43546, U.S.N.M. Paratypes, Cat. No. 42289, U.S.N.M.

Female.—General body form elliptical, short and plump; well rounded on both dorsal and ventral surfaces, more on the former than the latter. Carapace relatively large and semicircular, one-third of the entire length and one-half wider than long; the frontal and lateral margins form a nearly perfect half circle, surrounded by a wide transparent border; the posterior margin is three-lobed, the lateral lobes narrow and short, the median lobe three-fifths of the entire width and strongly convex. The anterior margin projects between the bases of the first antennæ, which are attached dorsally. Fused thorax segments broadly elliptical, one-fifth longer than wide, the segments indistinguishable except by indentations on the lateral

Digitized by Google

margins. The two anterior leg-bearing segments separated from the remainder by portions of a groove, extending inward from each lateral margin. Fifth segment bearing a good-sized hemispherical knob on its posterior border on either side, just external to the opening of the oviduct. The location of these knobs, combined with the position in which the egg-strings are habitually carried, suggests strongly that they are concerned in the support of the latter. Sixth (genital) segment indistinguishably fused with the abdomen, the two forming a triangular projection, one-half wider than long, attached to the center of the posterior border of the fifth segment, between the two knobs. The oviduct openings are dorsolateral, and as close as possible to the fifth segment. Anal laminæ conical, twice as long as wide, half the length of the fused sixth segment and abdomen, each tipped with three setæ of equal length, and having a short spine on the outer margin.

Egg-strings each one-third the width of the fused thorax and two-thirds of its length; eggs remarkably large compared with the size of the animal, only four or five in each case. The two cases are rotated until, with their bases touching at the midline, they are carried in front of a line at right angles to the body axis, and are actually curved forward like the points of a pickax, or even as far as the flukes of an anchor.

First antennæ indistinctly five-jointed, the same diameter throughout, only the three terminal joints armed with setæ; they are usually closely appressed to the lateral margins of the carapace. Second antennæ with a stout basal joint, which is contracted and curved inward at the distal end; terminal claw short, stout, and evenly curved. Mouth tube short, scarcely as long as wide, with a blunt tip; maxillæ reduced to mere knobs, destitute of spines or setæ. Maxillipeds with the two terminal joints together the same length as the basal joint, but only half the width of the latter. Swimming legs biramose, each ramus two-jointed; in the exopods the basal joint is the longer, in the endopods the terminal joint. In the first legs the basal joints are unarmed, the terminal endopod joint carries four short spines, the exopod three. In the second legs each basal joint is armed with a curved spine, on the outside in the exopod, on the inside in the endopod; the terminal exopod joint carries two curved spines, the endopod three.

Color variegated, the lateral margins a light olive-green, the ovaries and oviducts a light cinnamon-brown, the vascular space between the oviducts and intestine orange-yellow, the stomach and intestine contents a dark wine-red, filled with black globules along the center, which are most numerous at the anterior end.

Total length, 1 mm. Carapace, 0.31 mm. long, 0.4 mm. wide. Fused thorax, 0.7 mm. long, 0.55 mm. wide. Egg-strings, 0.45 mm. long, 0.15 mm. wide.

Digitized by Google

(*uncatus*, bent inward or curved like an anchor, alluding to the egg-cases.)

During the observation of these specimens while still alive it was noted that the usual peristaltic movements of the stomach and intestine were assisted by the drawing forward and backward of the oviduct on either side alternately. This movement was rhythmic and each oviduct was pulled nearly to the narrow neck between the head and first thorax segment.

The species can be told readily by the comparatively large size and small number of eggs and by the peculiar position of the egg-strings. In no other known species are they any more than divergent and pointing backward; here they actually point forward.

HATSCHEKIA INSOLITA, new species.

Plate 42, figs. 227–232.

Host and record of specimens.—Twenty females belonging to this species were obtained from the gills of the rock hind, *Epinephelus adscensionis*, during the summer. There were never more than one or two on a single fish, sometimes alone, sometimes in company with the preceding species (*uncata*). The present species was in full view while *uncata* was hidden between the filaments.

Type-specimen.—Cat. No. 43549, U.S.N.M. Paratypes, Cat. No. 42336, U.S.N.M.

Female.—Body of medium length and rather wide; carapace large and nearly circular, but with an irregular outline, and about one-third the entire length; dorsal median rib or keel of the carapace well developed. First and second thorax segments forming a short neck joining the carapace with the rest of the segments. Fused thorax club-shaped, one-half longer than wide, with the segmentation clearly indicated on the lateral margins; fifth segment with posterior lobes each as broad as the fused sixth segment and abdomen and reaching back farther than the latter. Fused sixth segment and abdomen only one-sixth the width of the fourth segment, hemispherical, and slightly contracted where it joins the fifth segment. Anal laminæ long and narrow, apparently two-jointed, the terminal joint tipped with three setæ.

Egg-cases club-shaped, from two-thirds to three-quarters the length of the body and taken together as wide as the fifth segment; eggs of large size, from four to seven in each case.

First antennæ long and narrow, about the same diameter throughout and poorly armed with spines. Second pair with a stout basal joint which is a little longer than the entire first antenna and armed with strong muscles. Terminal claw weak, abruptly narrowed to less than one-fifth the diameter of the basal joint, bent sharply at a right angle close to the base, and tapered to a fine needle point. In fact,

Digitized by Google

it is just the opposite in every particular of what would be expected on such a long and powerful basal joint. Mouth tube elliptical in outline with a squarely truncated tip, one-half longer than wide.

Maxillæ distinctly showing as papillæ on either side of the mouth tube, each tipped with three setæ very similar to those of the Ergasilidæ. Swimming legs with long and narrow basal joints, the proximal joint of the exopod longer than the one-jointed endopod. Third legs present as minute papillæ on the lateral margins, each tipped with two spines; fourth legs indicated by a pair of single spines, also on the lateral margins.

Color a uniform translucent yellowish-white, the eggs in the oviducts a light brown, those in the external sacks a dark seal-brown.

Total length, 0.85 mm. Carapace, 0.28 mm. long and wide. Fused thorax, 0.55 mm. long, 0.37 mm. wide. Egg-strings, 0.45 mm. long, 0.12 mm. wide at the distal end.

(*insolitus*, unusual, alluding to the second antennæ and the rudimentary third and fourth legs.)

Although found upon the same host as the preceding species, the present form is readily distinguished by the length of the second antennæ and the peculiar shape of their terminal claw and by the presence of the rudiments of the third and fourth pairs of legs in the sinuses on the lateral margins. In this last respect it resembles *Hatschekia* (*Clavella*) *labracis* Van Beneden.

HATSCHEKIA LINEARIS, new species.

Plate 44, figs. 240–246.

Host and record of specimens.—Ten females were obtained from the gills of the red-mouthed grunt, *Bathystoma rimator*, July 14, 1910. They were attached with their long axis parallel to the filament and on its outer surface.

Type-specimen.—Cat. No. 43551, U.S.N.M. Paratypes, Cat. No. 42293, U.S.N.M.

Female.—General body form linear, seven times as long as wide, and made up of four distinctly separated parts: the head; the first and second thorax segments partially fused; the third, fourth, and fifth segments completely fused; and the sixth segment and abdomen also completely fused. Carapace very small and circular, only one-ninth of the entire length, and a little narrower than the posterior body, with regular outlines; first and second antennæ entirely concealed in dorsal view. First and second thorax segments longer than the head, a little narrower anteriorly, but much widened posteriorly through the bases of the second legs. Fused third, fourth, and fifth segments linear, five times as long as wide and tapering slightly posteriorly, with nearly straight sides; third segment contracted into a narrow neck anteriorly where it joins the second segment, leaving the second

Digitized by Google

legs visible dorsally. Fifth segment forming a short and blunt lobe on either side of the genital segment posteriorly, the tip of the lobe just reaching the posterior margin of the opening of the oviduct. Fused sixth segment and abdomen semielliptical, about the same length and width, which is one-third that of the fifth segment. Anal laminæ minute and widely separated, each tipped with three setæ.

Egg-strings half the entire length, and half the width of the fifth segment, about twenty eggs in each string.

First antennæ short, their basal joints fused into a sort of rostrum, projecting from the center of the anterior margin, but curved over ventrally so as to be concealed beneath the carapace. They are apparently made up of only three joints, the terminal of which carries all the spines. Second antennæ with a stout and strongly curved terminal claw, half the length of the basal joint. Mouth tube wide and very bluntly rounded at the tip so as to be nearly circular in ventral outline. The two terminal joints of the maxillipeds are longer than the stout basal joint, and are tipped with a curved claw, which has an accessory spine at the center of its inner margin. There is also a short curved spine projecting from the top of a small papilla on the ventral surface of the head between the base of the maxilliped and the midline. This is not the rudiment of the maxilla since it is behind the chitin rib which supports the maxilliped.

Swimming legs with two-jointed exopods and one-jointed endopods, and with a stout spine on the basal joint inside of the endopod. Both rami of the first pair are tipped with four spines; the exopod of the second pair has two, the endopod three.

The ovaries and oviducts extend the entire length of the third, fourth, and fifth thorax segments; the maturing eggs are orange-brown in color; the cement glands are close to the midline inside of the oviducts, and are one-fourth the length of the latter, with a short glandular portion.

Color of the head yellowish-gray, translucent; free thorax brownish-yellow; genital segment a deeper brown; oviducts and egg-strings medium orange-brown; lateral margins of the free thorax and genital segment with an olive-green tinge; central line over the intestine yellow, bordered with orange. In many specimens the muscles of the head and free thorax are deep red, showing prominently through the translucent carapace and dorsal epidermis.

Total length, 2.33 mm. Carapace, 0.26 mm. long and wide. First and second thorax segments, 0.33 mm. long, 0.39 mm. wide. Third, fourth, and fifth segments, 1.75 mm. long, 0.33 mm. wide. Egg-strings, 1.2 mm. long.

(*linearis*, narrow, thread-like.)

This species is radically different from all the others that have been obtained in several particulars. The most striking peculiarity is the

Digitized by Google

separation of the two leg-bearing thorax segments. In most other species these are more or less fused with the three following segments to form the so-called "body" of the copepod. Here they are entirely separated and the species may be recognized by this separation at a glance.

If any essential differences could be found in the appendages, such a separation would warrant the establishment of a new genus, but as the appendages are in every way similar to those in all *Hatschekia* species, it seems best to locate this new form in that genus. Another difference is the long distance between the mouth parts and the first swimming legs. Usually these first legs are so close to the maxillipeds that they are often partially concealed beneath the latter. Here there is a wide interval between the two.

The species is quite common, nearly every fish yielding specimens, but it is not at all numerous, as only two or three specimens could be found on any one fish, and the most careful search of many fish failed to reveal a single male. In the separation of the two leg-bearing segments and in the relative position of the mouth parts and first legs *Hatschekia* (*Clavella*) *tenuis* Heller closely resembles the present species, but the two differ radically in the relative proportions of the different parts of the body, as well as in the size and structure of the antennæ and mouth parts.

HATSCHEKIA IRIDESCENS, new species.

Plate 41, figs. 216–221; plate 44, fig. 247; plate 45.

Host and record of specimens.—About 50 females and 2 males were obtained from the gills of a porcupine fish, *Diodon hystrix*, 15 inches in length. The females were attached between the gill filaments, the great majority of them with their heads toward the base of the filaments, and all with their bodies parallel with the filaments. The males were attached to the tips of the filaments, and not at all securely.

Type-specimen.—A female, Cat. No. 43550, U.S.N.M. Paratypes, Cat. No. 42325, U.S.N.M.

Female.—Body short and of medium width; carapace very large, one-third of the entire length, semielliptical, three-fifths wider than long, the lateral and posterior margins a nearly even curve, the anterior margin four-lobed, a narrow lobe on either side of the median line, with a much wider one outside of it extending to the lateral margin. Dorsal surface with a median longitudinal keel extending its entire length, the strong muscles operating the second antennæ and mouth parts attached to it and showing as diagonal lines on either side of it.

Fused thorax elongate-ovate, one-half longer than wide, a little narrower than the carapace, with only the anterior segments indicated by lateral indentations. The two leg-bearing segments fused with

Digitized by Google

the others, the fifth segment forming a wide lobe on either side of the genital segment and abdomen, and extending a little beyond the posterior margin of the latter. Fused genital segment and abdomen semielliptical, one-sixth of the width of the third segment, one-half wider than long, with a nearly straight posterior margin; anal laminæ elliptical, a little longer than wide, each tipped with three setæ of equal length.

Egg-strings five-ninths of the body length, one-fourth as wide as long, each containing eight or nine large eggs.

First antennæ five-jointed, the joints diminishing regularly in size outwards and well armed with setæ and spines. Terminal claw of the second pair fully as long as the basal joint, bent at a right angle near the tip and with a swelling on the inner margin near the base. Mouth tube conical, widest near the base and tapering to a rather sharp tip; maxillæ simple pimples without setæ or spines; maxillipeds of the usual pattern, the two terminal joints about the same length as the much stouter basal joint. Exopods of the swimming legs two-jointed, endopods one-jointed, a slender spine outside the base of the exopods, the other spines as shown in the drawings.

Cement glands close to the median line, the glandular portion about half the entire length and showing no trace of segmentation. Semen receptacle a long median bag lying between the ducts of the cement glands, divided posteriorly, with a duct extending nearly at right angles to the long axis of the bag and opening close to the external orifice of each oviduct. In figure 255 a spermatophore may be seen with its long duct attached to this opening. Evidently the ducts of these spermatophores are not crossed as in some of the other copepods.

Color a translucent orange-yellow, deeper on the appendages and along the midline; oviducts dark cinnamon-brown; eggs in the external cases also dark brown, increasing in intensity with development.

Total length, 2.75 mm. Carapace, 1.33 mm. wide, 1 mm. long. Fused thorax, 2 mm. long, 1.28 mm. wide. Egg-strings, 1.75 mm. long, 0.33 mm. wide.

Male.—Body proportionally longer and narrower than that of the female; carapace nearly circular in general outline, but projecting a little anteriorly on the midline and reentrant posteriorly leaving a well-defined lateral lobe on either side. Near the center of the carapace a small eye can be seen on either side of the midline with a central mass fusing them together.

Fused thorax nearly three times as long as wide, with the segmentation clearly indicated along the lateral margins, even the first and second segments being separated by a deep marginal indentation.

Digitized by Google

Genital segment fused with the others and produced posteriorly into a short and blunt lobe on either side.

Abdomen one-jointed, one-third the width of the fused thorax, and enlarged a little posteriorly; anal laminæ large, three times as long as wide, one-half longer than the abdomen, each tipped with two large and stout spines, the inner of which is as long as the lamina itself. Appendages like those of the female, but longer and more slender. First antennæ carried at right angles to the body axis, and projecting more than half their length beyond the lateral margins of the carapace. Maxillipeds also projecting obliquely backward, with their entire length visible in dorsal view. First two pairs of swimming legs with two-jointed exopods and one-jointed endopods; there is also a rudimentary third pair of legs behind the second pair on the lateral margins; each consists of a single short joint tipped with two spines.

Total length, 1 mm. Carapace, 0.3 mm. long and wide. Fused thorax, 0.6 mm. long, 0.22 mm. wide.

Color like that of the female except that the brown oviducts are replaced by yellow sperm receptacles.

Nauplius.—Body elliptical, one-half longer than wide, with a regular curve; a narrow papilla-like protuberance at the center of the anterior margin, and a much wider one between the balancers, posteriorly. There are the usual nauplius appendages, the exopods of the second antennæ and mandibles carrying only four rowing setæ. Balancers slender and cylindrical, carried straight backward parallel with the body axis, each of them slightly convex inward. Body with three large masses of brown pigment, one triangular in shape, in the center of the anterior portion, the other two along each lateral margin, meeting posteriorly. Between and in front of these pigment masses the body is translucent and shows the usual diagonal muscles (see fig. 216).

Total length, 0.2 mm.; width, 0.11 mm.

(*iridescens*, iridescent, alluding particularly to the fully developed egg-strings.)

The burial of the large second antennæ of this species in the tissue of the gill filament of its host produces a sort of tumor or swelling, similar to that produced on the fins by the maxillipeds of *Tucca impressus*. But these parasites are not thereby anchored to one spot as is the case with *Tucca;* they are able to loosen their hold and move up and down the filaments by a walking motion of the second antennæ. Some of them free themselves entirely and wriggle off the gills on to the bottom of the aquarium, when the gills are removed from the fish and put in water. The females live a long time, lying on their backs and wriggling about violently, but they are unable to

Digitized by Google

swim at all. The males can swim readily but die much sooner than the females. Many of the egg-strings were ready to hatch and active nauplii were obtained, but none of them could be carried through even the first molt. In the matured egg-strings they show through the walls of the external cases with a peculiar iridescence, totally unlike anything seen in other copepods, and this has suggested the specific name for the new species.

Family LERNÆIDÆ.

PENNELLA EXOCŒTI (Holten).

Lernæopenna blainvillii LESUEUR, 1824, p. 289, pl. 11, figs. 2*e–k*.

Host and record of specimens.—This species was originally described by Holten in 1802 under the name *Lernæa exocœti*, and was obtained from the common flying fish, *Exocœtus volitans*, in the Atlantic Ocean. It was afterwards taken by Lesueur from the same host in the vicinity of the West Indies, and described and figured under the name *Lernæopenna blainvillii*. Lesueur found a second specimen, on the same fish and close to the one just mentioned, but so different from it that he was at a loss just where to place it; he suggested that the two might be different sexes of the same species (1824, p. 292). This second specimen Milne Edwards made the type species of his new genus *Lernæonema* (1840, p. 524), but Richiardi has suggested (1877, p. 199) with greater probability that it is an undeveloped *P. exocœti*.

THERODAMAS SERRANI Krøyer.

Therodamas serrani KRØYER, 1863, p. 316, pl. 15, figs. 4*a–f*.

Host and record of specimens.—Krøyer obtained a tolerably large number of females of this Lernæid from the gills of a *Serranus* species in the Danish West Indies. He established for them (1863, p. 316) a new genus and species which seem to be well founded, but no other investigator has ever obtained any specimens. This is the more to be regretted because the parasite is very peculiar in many respects, but although all the species of *Serranus* as well as other groupers were carefully examined, nothing of the sort could be found at Jamaica.

LERNÆOLOPHUS HEMIRAMPHI (Krøyer).

Lernæa hemiramphi KRØYER, 1863, p. 318, pl. 15, figs. 7*a–f*.

Host and record of specimens.—A single specimen of this species was obtained from the mouth opening of a *Hemiramphus*, species, probably *H. brasiliensis*, from the Danish West Indies. Upon this specimen Krøyer established his new species (1863, p. 318), and so far as can be judged it seems perfectly valid.

Digitized by Google

LERNÆOLOPHUS RECURVUS, new species.

Plate 46.

Host and record of specimens.—Four females, one of which was a young developmental stage, were obtained from the gill arches of the blue parrot fish, *Scarus cæruleus*, June 30, 1910. Three of these were found upon a single fish, and were close together in the floor of the throat, where the gill arches join.

Type-specimen.—Cat. No. 43557, U.S.N.M. Paratypes, Cat. No. 42292, U.S.N.M.

Female.—General body form slender, the head nearly spherical and about twice the diameter of the neck, the posterior body club-shaped but not much enlarged, the abdomen narrowed to half the diameter of the genital segment. Body also bent into a half circle so that the genital segment and abdomen point forward toward the head. In fully matured specimens the abdomen is covered with a dense growth of dichotomous processes.

Head flattened a little dorso-ventrally, and armed on its dorsal surface with three chitin horns, all at right angles to the body axis and dichotomously branched. The two lateral horns are considerably larger than the posterior one, their length being three or four times the diameter of the head, and are three times compounded. The posterior horn is much shorter, its length only once and a half times the diameter of the head, and is only twice compounded. Usually one or the other lateral horn is enlarged at the base, and the branches of all the horns taper regularly toward the tips.

There is hardly a trace of the two small knobs on the top of the head, which represent the first antennæ in *L. sultanus*.

On the flattened ventral surface, or face of the head, may be found the second antennæ and mouth parts. The former are in the shape of short and stumpy processes along what may be called the forehead of the parasite and down either side of the face. Each consists of two parts which evidently belong together and which are united in early development, but become more or less separated later. Behind these on the lower sides of the face and along the chin are the maxillipeds, also represented by stumpy processes, flattened and irregular, and showing more or less tendency to become bipartite. The space between the second antennæ and maxillipeds is hollowed out into a shallow cup, in the bottom of which are three small spherical knobs of about the same size, one posterior on the median line, and in front of this a pair, one on either side of the median line. The former is the rudiment of the under lip, the latter of the mandibles.

In front of the mandibles in some of the specimens may be seen a slight elevation on the median line which represents the last traces of the upper lip. In the developmental stage the upper and under

Digitized by Google

lips are prolonged and loosely united into a sort of proboscis, and the mandibles form swellings at its sides.

Just behind the head are four pairs of rudimentary legs, so close together that they overlap for two-thirds of their length. Each leg consists of a broad triangular lamina, representing the basal joint, and two tiny spines, representing the rami. In the developmental stage they stand out nearly at right angles to the ventral surface, in the adult they are tightly appressed to that surface. The first four (leg-bearing) thorax segments are narrow and neck-like and very short; the fifth segment is of the same width and greatly elongated, and forms the bulk of the so-called neck; the genital segment is enlarged to two or three times the diameter of the neck, varying considerably in different individuals. It is impossible in this species to locate accurately the dividing line between the fifth and genital segments, but judging from the following species the point where the enlargement begins is the line of demarcation.

At about the center of the enlarged genital segment the body is bent abruptly so that the abdomen points toward the head.

In the developmental stages the curve is broad and there is but little twisting of the body; in the mature adult the curve becomes so sharp that the dorsal surface of the abdomen is brought almost into actual contact with the side of the fifth segment. At the same time, the posterior portion of the body is twisted to the right or left, so that the legs and mouth-parts appear to be on one of the lateral surfaces.

The abdomen is long and slender, and tapers gradually from base to tip; at the base it is about half the diameter of the genital segment, and on a level with the dorsal surface of the latter. It shows no external signs of segmentation. On the sides of the genital segment at the posterior end are two pairs of dichotomously branched processes, and along the lateral margins of the abdomen are seven or eight additional pairs. At first these are short and simple and do not conceal the surrounding parts, but they increase in size and complexity with age, and finally cover and conceal the abdomen, egg-strings, and posterior portion of the genital segment.

The egg-strings are scarcely wider than one of the processes, but are from one and a half to two times the length of the body. Each is tightly and irregularly coiled into a small mass, entirely surrounded by the processes, and in this way supported and protected.

Color of the entire body blood- or wine-red, even to the tips of the horns; dichotomous processes pale yellow-gray or straw-color; egg-strings snow-white.

Total length, 20 mm. Length of horns, 5 mm.; of processes, 6 mm. Diameter of head, 2.8 mm.; of neck, 1 mm.; of genital segment, 2.8 mm.

Digitized by Google

(*recurvus*, bent back, alluding to the posterior portion of the body.)

In 1840 Milne Edwards very briefly described what he called a new species of *Pennella*, *P. sultana*. In 1864 Nordmann figured and described a new variety of the same species, *P. sultana sigmoidea*. In 1865 Heller established the new genus *Lernæolophus* upon some specimens which he identified as identical with those described by Milne Edwards.

No one of the three descriptions, nor even all of them together, are very complete, especially with regard to the mouth parts, but enough is shown to fully establish the validity of the genus.

Milne Edwards does not even mention the mouth parts; Nordmann shows a series of 11 small papillæ arranged in the shape of an ellipse, the anterior one unpaired on the midline, the others more or less regularly paired. Heller claimed to distinguish a pair of antennæ on the front of the head, and around the mouth one pair of "palps" and two pairs of "maxillipeds." These last three pairs of appendages he described as being armed with terminal "claw-joints," and the second maxillipeds as being distinctly three-jointed. He makes no mention of the small papillæ in the bottom of the mouth depression, nor does his figure show them. If they were present the total number would be the same as that given by Nordmann, but the arrangement would be radically different. If there really were three pairs of claws around the mouth, they must have represented the second antennæ, a pair of maxillæ, and a pair of maxillipeds. In the present species, however, there are no traces of any claws, and the two anterior pairs of papillæ that look like separate appendages in the adult, are certainly parts of the same single pair in the developmental stage. This would indicate that the maxillæ are entirely lacking, as in other genera belonging to this family.

The present species is sufficiently distinguished from *sultanus* by the comparatively smaller size of the head, by the branching of the posterior horn, by the fact that the body is bent only once and then very sharply, instead of into a broad sigmoid curve, and by the overlapping of the four pairs of legs. Also if Heller's description of the mouth parts is correct, they are much better developed in *sultanus* than in *recurvus*.

The fact that no satisfactory description has ever been given of any species of the genus is sufficient warrant for the present somewhat detailed one.

LERNÆOLOPHUS STRIATUS, new species.

Plate 47, figs. 260, 261.

Host and record of specimens.—Two females were obtained from the throat of the barracuda, *Sphyræna barracuda*, July 15, 1910. They were fastened to the floor of the throat, just inside the lower lip. The

Digitized by Google

head was buried close to the ventral aorta, while the body trailed back along the gill arches, The better specimen of the two has been made the type.

Type-specimen.—Cat. No. 42320, U.S.N.M.

Female.—General body form slightly curved and slender; diameter almost uniform throughout, only slightly enlarged posteriorly. Horns long and slender and profusely branched; posterior processes all pointed backward, crowded together, and unbranched.

The dividing line between the fifth and sixth (genital) segments is clearly indicated by a transverse groove and also by a marked change in color. This groove is situated at the beginning of the posterior enlargement of the body, and the color changes from wine-red to a dull white. Head flattened more than in *recurvus* and projecting much farther in front of the base of the horns. Lateral horns four times compounded; posterior horn not at right angles to the body axis, but pointing diagonally backward, almost parallel with the thorax, and three times compounded. Sides of the head fluted or wrinkled, the wrinkles extending around to the bases of the second antennæ and mouth parts on the front of the head. First antennæ practically wanting, only the merest vestiges of knobs being left; second antennæ and mouth parts similar to those of *recurvus*, but with these differences. The knobs representing all the appendages are relatively larger; the maxillipeds are much more irregular and are fully twice the size of the second antennæ, and there is much less space between the two at the sides of the head. The mouth depression is shallower, but the form, size, and arrangement of the three small knobs is almost exactly the same.

The swimming legs are smaller than in *recurvus*, not as distinctly triangular, and they have no spines; they are also farther apart so that they do not even touch one another. The genital segment is not recurved, but is bent only slightly out of a straight line. The egg-tubes are coiled into tight bundles, entirely concealed by the posterior processes; each, if straightened out, would be about one and a half times the length of the body.

Total length, 27 mm. Length of horns, 7.5 mm.; of posterior processes, 6.5 mm. Diameter of head, 2.7 mm.; of neck, 1.6 mm.; of genital segment, 2.6 mm.

Color of the anterior body and horns a pale wine-red, of the genital segment a dull white, of the appendages a pale yellow.

(*striatus*, fluted or grooved, alluding to the sides of the head.)

This species is readily distinguished by the fluted head, large second antennæ and mouth parts, straight body, and posteriorly pointing and unbranched processes.

Digitized by Google

Family LERNÆOPODIDÆ.

Genus THYSANOTE Krøyer.

THYSANOTE POMACANTHI Krøyer.

Thysanote pomacanthi KRØYER, 1863, p. 288, pl. 15, figs. 1*a–i*.

Host and record of specimens.—Krøyer obtained half a score of specimens from the gills of the Indian or flat-fish, *Pomacanthus paru*, from the Danish West Indies. Upon these he established the new genus, *Thysanote*, and the new species, *pomacanthi*, which became the type of the genus.

Two years later Heller said (1865, p. 238) that Krøyer's genus was nothing but a "*Brachiella*" with numerous processes on the arms and posterior body, and he described two new species which he referred to the genus *Brachiella*. But neither Krøyer nor Heller found the males of the species they described. Nordmann, however, had previously described and figured (1832, p. 92, pl. 8, figs. 1 to 3) both sexes of "*Brachiella impudica*," which have since been referred to the genus *Thysanote* by Bassett-Smith (1899, p. 497), T. Scott (1900, p. 169), and A. Scott (1904, p. 123).

Steenstrup and Lütken also described and figured (1861, p. 419, pl. 15, fig. 35) both sexes of "*Brachiella appendiculata*," which evidently belongs to this genus *Thysanote*, and Bassett-Smith described and figured (1898, p. 14, pl. 6, figs. 1 to 3) both sexes of "*Brachiella appendiculosa*," which he afterwards acknowledged (1899, p. 497) to be identical with Steenstrup and Lütken's species.

These last two males correspond with the one here described, as do the females, and may therefore be taken as typical of the genus.

There are far more differences between the males and those of true *Brachiella* species than there are between the females, but even with the latter the differences are enough to establish the validity of the genus. There is no one thing besides the fimbriate processes which can be regarded as a conclusive generic character. Rather is the genus distinguished by an accumulation of small and not very prominent differences, which may be summed up as follows:

Female.—Cephalothorax short and thickset, and in the same line with the rest of the body; completely fused with the remainder of the thorax or only imperfectly separated; segmentation indicated by breaks in the musculature. The arms (second maxillæ) and posterior margin or corners of the body bearing fimbriate processes; no abdomen, anal laminæ very rudimentary.

First antennæ between the terminal joints of the second pair and the mouth, visible only from below, indistinctly segmented. Second pair closely appressed to the frontal margin of the head and just meeting at the midline; mandibles with a pronounced curve near the center of the blade; first maxillæ large, with a distinct palp;

Digitized by Google

second maxillæ sometimes longer than the cephalothorax, united only at the tip; maxillipeds with a powerful basal joint and a short terminal claw.

Male.—Body short and thickset; cephalothorax more or less completely separated from the posterior unsegmented portion; the latter terminated by two conical anal laminæ. Appendages on the ventral surface at right angles to the body axis; second antennæ uncinate; second maxillæ with stout sickle-shaped claws; terminal portion of the maxillipeds twisted like a corkscrew.

THYSANOTE LONGIMANA, new species.

Plate 47, figs. 262–264; plate 48.

Host and record of specimens.—Five females and three males were obtained from the outside of the throat of the red snapper, *Neomænis aya*, July 23, 1910.

Type-specimen.—A female, Cat. No. 43552, U.S.N.M. Paratypes, Cat. No. 42281, U.S.N.M.

Female.—General body form elongate, widest posteriorly; divided into two regions, the cephalothorax and the fused thorax and abdomen. Cephalothorax oblong, one-third of the entire length, bluntly rounded anteriorly, and enlarged posteriorly through the bases of the second maxillæ. Body inversely club-shaped, with a smooth surface and evenly rounded outlines, the only trace of segmentation being found in the interruption of the longitudinal muscles which run along the midline on both the dorsal and ventral surfaces. There are three of these muscle breaks, making four segments, the last of which is a fusion of the fifth and sixth (genital) segments, and the abdomen. The egg-tubes are attached to the posterior margin of this fused segment, nearer the dorsal than the ventral surface; they are cylindrical in form and about two-thirds of the entire length. The eggs are rather small and are arranged in five or six longitudinal rows, from 25 to 30 eggs in each row. There are eight of the branched processes which characterize the genus; the first pair are attached to the arms about one-third of their length from the base; the second pair are attached to the arms where the latter join the body, so that in some specimens they seem to come from the sides of the body; the third and fourth pairs are close together at the posterior corners of the last (fused) body segment. The branching is dichotomous, and none of the rami are divided more than once or twice, making the processes comparatively simple.

Between the egg-tubes, on either side of the anus, and on a level with the ventral surface, is a short, finger-like process.

First antennæ imperfectly segmented and tipped with a pair of very short spines, but without any other armature. Owing to the

Digitized by Google

pushing forward and curving inward of the second antennæ, this first pair comes to lie between the second pair and the mouth tube, and can be seen only from the ventral surface (fig. 267).

In consequence of this abortive position they have been frequently mistaken for other appendages. Second antennæ of the usual biramose form, bent across the anterior margin of the head at right angles to the body axis, with their tips just meeting on the midline above the mouth tube. Exopod broad, one-jointed, and bluntly rounded; endopod two-jointed, much narrower, and tipped with two spines. Mandibles mounted on a prominent and powerful basal joint, just outside the base of the mouth tube; blade curved near the center and armed with teeth of two sizes, about 12 in all.

First maxillæ large and stout, bipartite at the tip, each ramus ending in a single stout spine; palp on the inner, ventral surface, just below the rami, short and tipped with two spines.

Second maxillæ or arms one-half longer than the cephalothorax, joined only at the tips, where is formed a short but strong mushroom bulla.

No swimming legs visible anywhere upon the body. In the ripe female the entire body behind the cephalothorax is filled with the small eggs.

Color a uniform yellowish-white, without pigment.

Total length, 8 mm. Cephalothorax, 2.2 mm. long, 1.2 mm. wide. Posterior body, 6.8 mm. long, 2.2 mm. wide. Egg-tubes, 4 mm. long.

(*longimana*, *longus*, long, and *manus*, hand, alluding to the length of the arms or second maxillæ.)

Male.—General body form spindle-shaped and rather thickset; divided into two regions by a well-defined groove. Cephalothorax in the form of half a short cone, covered with a carapace which projects anteriorly and along the sides over the bases of the appendages. Thorax-abdomen a long and bluntly rounded cone, twice the length of the anterior one and not as wide, ending posteriorly in a pair of narrow conical anal laminæ.

First antennæ attached to the sides of the carapace some little distance back of the anterior end, indistinctly jointed and tipped with two tiny spines. Second antennæ close behind the first, with a biramose tip, the exopod of which ends in a sickle-shaped claw.

First maxillæ between the base of the antennæ and the mouth tube, projecting considerably beyond the tip of the latter; the two terminal spines and palp like those of the female. Second maxillæ short and stout and pointed forward, the terminal claw also short and stout, sickle-shaped, with its point almost in contact with the end of the basal joint.

Maxillipeds long and rather slender and pointed backward; second joint and terminal claw bent into a sort of corkscrew, which with its fellow is ordinarily concealed between the two maxillipeds.

Digitized by Google

Color yellowish-brown, considerably darker than the female. Total length, 1.35 mm. Greatest width, 0.5 mm.

CLAVELLA (ANCHORELLA) LACINIATA Krøyer.

Plate 49.

Anchorella laciniata KRØYER, 1863, p. 308, pl. 16, figs. 8*a* and *b*.

Host and record of specimens—Krøyer obtained two females from the gills of a fish which he designated as "*Acanthurus chirurgus*," but which is now known as *Teuthis hepatus*, the doctor fish, from the Danish West Indies. Upon these he founded a new species of the genus *Clavella* (*Anchorella*), which he named *A. laciniata*.

During the season of 1910 five females and two males were found attached to the skin in the roof of the mouth of the same host at Montego Bay, Jamaica. Cat. No. 42310, U.S.N.M.

Female.—General body form short and plump; cephalothorax longer than the posterior body and nearly reaching the ends of the egg-strings, flexed backward against the dorsal body surface, and of the same diameter throughout. Not only are the arms entirely lacking but the attachment bulla is even placed at the bottom of a pit, below the level of the body surface. Posterior body bell-shaped, the apex and one side of the bell fastened to the cephalothorax, the margin laciniate or cut into conical processes, six in number, two posterior, two lateral, and two anterior, while the mouth of the bell, between the bases of the processes, is covered by the posterior body wall. The anterior and posterior processes are about equal in size, and are one-third the length of the posterior body; the lateral processes are much smaller.

Abdomen, situated in the angle between the two posterior processes, minute and nearly spherical. Egg-cases ellipsoidal, half the length and width of the posterior body, and attached to the flattened surface between the bases of all the processes; eggs large, arranged in five or six rows, about 10 in each row.

First antennæ conical, distinctly three-jointed, the last joint tipped with two spines, the others unarmed. Second antennæ closely appressed to the anterior margin and bipartite at the tip, the inner ramus two-jointed and ending in a claw, the outer one one-jointed and unarmed. Proboscis a broad cone, projecting prominently from the ventral surface of the head.

First maxillæ ending in two long spines; palp minute, one-jointed, attached to the inner margin close to the distal end.

Maxillipeds with a swollen triangular basal joint, and a slender, nearly straight terminal claw. The latter is attached to the side rather than the tip of the basal joint, and carries an accessory spine on its inner margin toward the tip. Near the center of the inner mar-

Digitized by Google

gin of the basal joint is a papilla which carries a long seta; just below this are two rounded knobs covered with short spines.

Color a dark yellowish-white, turning to lavender and then purple on the posterior processes and the dorsal surface.

Total length, 4.4 mm. Cephalothorax, 2.5 mm. long, 0.55 mm. wide. Posterior body, 1.45 mm. wide at the posterior end, 3 mm. long, including the posterior processes which are 1 mm. long. Egg-cases 1.3 mm. long, 0.65 mm. wide.

Male.—General body form that of a typical *Clavella* male, ovate, flattened laterally, a little pointed anteriorly, abruptly rounded, and considerably abbreviated posteriorly, without any trace of regions or segments. The entire dorsal surface is covered with a carapace, which projects a little over the anterior margin, forms a distinct ridge along the sides of the body, and fades away imperceptibly posteriorly.

First antennæ three-jointed and considerably enlarged at the base; second pair flattened and laminate, projecting at right angles to the edge of the carapace, about the same length as the first pair, the outer, terminal ramus cut off diagonally.

First maxillæ like those of the female; second pair ending in stout curved claws; maxillipeds with a strongly swollen basal joint, having on its ventral margin a tooth-like projection with which the tip of the terminal claw interlocks.

Color a creamy yellow, uniform all over the body.

Total length, 0.5 mm. Greatest width, 0.33 mm.

Nauplius larva.—General structure the same as that in the other Lernæopodidæ. Body a flattened ellipsoid, the two diameters in the proportion of 3 to 4, the margins evenly rounded. Frontal gland very large and situated far forward near the anterior margin; no other internal structures visible except the muscles which move the appendages. Of these latter there are only two pairs, corresponding to the first and second antennæ. The first pair are one-jointed, uniramose, and tipped with two long setæ; the second pair are biramose, the exopod five-jointed, each joint terminating in a long seta, the endopod two-jointed, and terminating in two setæ. At the posterior end of the body there are no balancers, but instead a large rounded knob, made up of the fused thorax and abdomen.

The entire body is uncolored except six isolated patches of dark lavender or purple pigment. The first two pairs are situated on either side of and close to the eye, the remaining and largest pair at the posterior corners of the body.

(*laciniata*, cut into deep and irregular lobes, alluding to the posterior processes.)

This species was briefly described and figured by Krøyer in 1863 (p. 308, pl. 16, fig. 8*a* to *b*), and has never been seen by subsequent

Digitized by Google

investigators. Krøyer's description lacks practically all the details with reference to the appendages and his figures are so small that nothing can be learned from them about the appendages. Accordingly the species has been redescribed, the details of structure have been added, and the male and nauplius larva have been presented for the first time.

This male proves to be a typical *Clavella* (*Anchorella*) form, so that Krøyer located the species correctly in spite of the presence of three pairs of posterior processes around the egg-strings that might have suggested a relationship to *Brachiella*.

The nauplius larva was dissected out of the egg-strings and compares closely with that obtained in a similar manner from the egg-strings of *Achtheres ambloplitis*.[1]

The species may be recognized by the bell-shaped posterior body, with the conical processes around its flaring mouth, and the short and thickset egg-cases protruding from the latter like a pair of tongues or clappers.

CLAVELLA INVERSA, new species.

Plate 50.

Host and record of specimens.—Six females were obtained from the gills of the red-mouthed grunt, *Bathystoma rimator*, July 18, 1910.

Type-specimen.—Cat. No. 43513, U.S.N.M. Paratypes, Cat. No. 42291, U.S.N.M.

Female.—General body form short and very thickset. Cephalothorax flexed backward so that it is in the same line with the arms and at right angles to the rest of the body. Head club-shaped, its diameter a little less than that of the neck, its anterior margin squarely truncated, with the proboscis and first antennæ projecting slightly. At the junction of the neck with the posterior body, which is also the point from whence arise the arms or second maxillæ, there is present on each lateral margin and nearer the dorsal than the ventral surface a large kidney-shaped knob. These knobs are very conspicuous in both living and preserved specimens and furnish a ready means of recognizing the species. So far as is known, nothing of this sort has ever been observed in any other species of the genus. The knobs are covered with the outer skin so thickly that their presence is indicated merely by a wrinkled swelling, but, the skin being transparent, they are perfectly visible inside the swelling. They appear to be the maxillary glands, crowded out of their normal position in the second maxillæ, for ducts may be seen on their dorsal surface leading inward and upward and opening at the base of the second maxillæ. The latter are short and completely fused, except the internal muscles, which still indicate their double origin. The attachment bulla is large, saucershaped, and sessile, with the stem entirely lacking.

[1] Proc. U. S. Nat. Mus., vol. 39, pl. 30, figs. 10 and 11.

Digitized by Google

The posterior body is transversely elliptical, a trifle wider than long, with a strongly convex ventral surface and an equally concave dorsal surface. At the center of the posterior margin, on a level with the ventral surface, is the tiny abdomen, which is short, obovate, and strongly flattened dorso-ventrally.

The egg-strings are ellipsoidal, each three-fourths as long as the posterior body and half as wide; the eggs are very large and are arranged in six or seven rows, about five in a row.

First antennæ three-jointed, the two terminal joints slender, tipped with two short spines, and projecting well beyond the anterior margin of the head, the basal joint swollen and armed with a single spine on the inner margin near the distal end. Second antennæ flexed at a right angle and appressed close to the anterior margin of the head, their tips meeting at the midline. Proboscis broadly conical, its tip reaching a little beyond the frontal margin. First maxillæ ending in two spines of about equal size; palp also tipped with two small and equal spines and situated on the ventral surface near the center.

Maxillipeds with a swollen basal joint, armed with powerful muscles, having a stout spine at the center of the inner margin and a rounded elevation covered with short spiny teeth at the distal end of the same margin. Terminal claw slender and a little more than half the length of the basal joint, with a short accessory spine near the tip.

Color a clear yellowish-white, without pigment.

Total length, 3.45 mm. Cephalothorax, 1.65 mm. long, 0.6 mm. wide. Posterior body, 1.75 mm. long, 1.8 mm. wide. Egg-strings 1 mm. long, 0.7 mm. wide.

(*inversus*, contrary to the usual order of things, the maxillary glands in this species being outside the maxillæ.)

This is a small and highly interesting species which may be recognized at once by the kidney-shaped knobs on the sides of the cephalothorax at the bases of the second maxillæ.

It is fairly common, having been found on several of the red-mouthed grunts, but it is so small and it blends so well with the gill filaments that it is easily overlooked.

BRACHIELLA CONCAVA, new species.

Plate 51, figs. 284–288.

Host and record of specimens.—A single female of this species was taken from the gills of the sting ray, *Dasyatis hastata*. It was fastened to the gill arch close to its base and on the inner margin away from the gill filaments.

Type-specimen.—Cat. No. 42286, U.S.N.M.

Female.—General body form short and plump; cephalothorax folded back against the dorsal body surface until it is in the same

Digitized by Google

straight line with the arms and about the same length as the latter. Head half as wide again as the neck, nearly cylindrical, and covered on the dorsal surface with a skin-like carapace, which does not reach the anterior margin; neck the same diameter as the arms. Body oval, strongly flattened dorso-ventrally, with the dorsal surface concave or saucer-shaped and its raised margin crenulate. One pair of thick cylindrical processes at the posterior end, on a level with the dorsal surface and well separated. These processes are narrowed to a short neck anteriorly and bluntly rounded posteriorly. They start on either side of the dorsal midline and close to it, and run a short distance at right angles to the body axis, then turn and become parallel with the latter and with each other.

The abdomen and anal laminæ are both lacking. The egg-strings are cylindrical, the same diameter as the posterior processes, and twice as long as the body proper; the eggs are arranged in four or five longitudinal rows, about 50 in a row.

First antennæ very indistinctly segmented, the basal segments much larger than the terminal, the whole appendage turned over ventrally nearly at right angles to the dorsal surface. Second antennæ appressed to the anterior margin of the head, not meeting at the midline, but leaving a gap equal in width to the diameter of the antennæ. Proboscis projecting slightly in front of the head, between the ends of the second antennæ.

First maxillæ short and stout, not reaching beyond the center of the mouth tube, with three terminal spines of about equal length; palp at the center of the inner margin, tipped with two short spines. Second maxillæ about as long as the head and neck, separate to the very ends, where they are slightly enlarged and fused into a rounded knob which supports the bell-shaped bulla.

Maxillipeds with a swollen basal joint, armed on the inner margin near the base with a rounded knob covered with short spines, and a long flexible spine at the center; terminal claw short and weak, with an accessory spine at its base.

Color of the head and neck a clear cartilage gray, the body yellowish, the complicated uterine processes of the oviducts white; egg-strings straw-yellow, becoming deeper as the eggs develop.

Total length, without the egg-strings and posterior processes, 11 mm. Cephalothorax, 6.2 mm. long, 1.4 mm. wide. Arms, 5 mm. long. Posterior processes, 3.2 mm. long. Egg-strings, 7.25 mm.

(*concava*, hollowed out, alluding to the dorsal surface of the body.)

This species is one of those that have but two posterior processes, and among them may be recognized by the size and shape of those processes, as well as by the large size of the parasite itself. It is not common, since a large number of sting rays yielded but this one specimen.

Digitized by Google

Family CANTHOCAMPTIDÆ.

CANCRINCOLA, new genus.

Generic characters.—Body made up of 10 segments, slender, cylindrical or somewhat spindle-shaped, the anterior end of the spindle much shorter than the posterior. Cephalic segment short and narrowed anteriorly; rostrum minute and rudimentary. Free thorax segments diminishing slightly but regularly in width from in front backward. Fifth and sixth segments more distinctly separated than in *Canthocamptus*. First abdomen segment about as wide as the genital segment, the two others somewhat narrower; anal laminæ short and rather stout, each bearing an enormous curved seta, half as long as the entire body or more; no anal opercle.

Anterior antennæ stout and thickset, eight-jointed, those of the male strongly hinged. Posterior antennæ short, the outer ramus very small and one-jointed; mandibular palp simple and also one-jointed.

Anterior maxillæ with well-defined endopod and exopod, the latter armed with a stout, claw-like spine; posterior maxillæ with only a single digitiform lobe inside the claw-bearing joint; maxillipeds normally developed.

First swimming legs with the inner ramus two-jointed, much longer than the outer one, and modified for clasping; other swimming legs with the outer ramus longer than the inner, both rami three-jointed; fifth pair in the female distinctly lamellar, with the basal joint expanded on the inner side. Only a single ovisac.

Type species—*Cancrincola jamaicensis*, new species.

(*Cancrincola*, *cancer*, a crab, and *incola*, dweller or inhabitant.)

CANCRINCOLA JAMAICENSIS, new species.

Plate 50, fig. 281; fig. 51, figs. 282, 3; plate 52.

Type.—One female, Cat. No. 43506, U.S.N.M., taken from the gills of the white land crab, *Cardisoma guanhumi*, at Montego Bay. Paratypes, 30 specimens, including both sexes, taken from the same host, Cat. No. 43596, U.S.N.M.

Female.—Body slender, more than four times as long as wide, cylindrical, tapering gradually posteriorly. Cephalic segment slightly longer than the two following segments combined, strongly narrowed anteriorly; rostrum very small and triangular. Eye well developed and placed far forward.

First free segment a trifle wider than the cephalon and considerably longer than any of the following segments; fifth and sixth segments distinctly separated; first abdomen segment wider and longer than either of the two which follow it; terminal segment deeply incised at the center and without any anal opercle.

Digitized by Google

Anal laminæ much shorter than the terminal segment and thickset, each armed with three short spines at the outer distal corner and two similar ones at the inner distal corner. Between these on the end of each lamina is attached a stout seta five-ninths as long as the entire body; each seta is curved outward at the center, the two resembling a pair of parenthesis marks.

Anterior antennæ indistinctly eight-jointed, considerably shorter than the cephalon, and thickset; the four basal joints are well supplied with setæ of moderate size, on the four terminal joints the setæ are scattering, except a tuft at the very tip; the fourth joint projects somewhat on the anterior margin and is there armed with two long and narrow æsthetasks.

The posterior antennæ are of moderate size, the basal joint with a single small spine on its inner margin; exopod attached at the center of the outer margin, short, one-jointed, and terminating in three setæ, the longest of which is posterior; terminal joint two-thirds the length of the basal, armed with a double row of saw teeth (proximal portion) and three toothed spines (distal portion) along its inner margin; three long spines toothed near their tips, and a shorter one toothed at its center, are attached to the distal margin of this terminal joint.

Mandibles peculiar, the outer ramus very small, simple, one-jointed, and terminating in two long and two short spines, the two former between the two latter; inner ramus flattened into a semicylindrical lamina or blade, the distal end of which is narrower than the basal; cutting portion projecting from the inner surface of this lamina at the distal end as a short, sharp, and toothed process. The concave surfaces of the laminæ face each other so that, when the mandibles are closed together, the laminæ form a short conical tube or proboscis, through which liquid food might well be conveyed to the mouth.

First maxillæ with an exopod made up of one stout curved spine and two smaller ones; endopod a flattened lamina, terminated by a row of short spines. Second maxillæ with a stout exopod terminating in a long curved claw; endopod shorter, with a tuft of small spines at the end.

Maxillipeds with a short and stout basal joint, a swollen second joint, and a slender terminal claw, curved to fit the surface of the second joint and toothed along its inner margin. First four pairs of legs biramose; endopod of the first pair twice the length of the exopod, two-jointed, the basal joint almost four times as long as the terminal, the latter ending in a stout claw and a long slender seta, the former with a long seta on its ventral surface and a shorter one on its outer margin. Exopod of first pair and both rami of the second, third, and fourth legs three-jointed, the spines and setæ arranged

Digitized by Google

as follows: First exopod, III—0, IV—5, V—2; second endopod, III—1, IV—1, IV—3. Second exopod, II—0, IV—1, IV—4; third endopod, II—1, III—1, VI—4; third exopod, I—0, I—1, IV—3; fourth endopod, 0—1, III—0, IV—4. Fourth exopod, I—0, V—0, VI—2. Fifth legs uniramose, lamellar, two-jointed, the basal joint with a single seta on the outer side and expanded on the inner side into a broad lamina terminated by four setæ; distal joint narrow oblong, terminated by four slender setæ.

No females were found with attached egg-cases, but the external opening of the oviducts was single, showing that there can be but a single egg-case.

Total length, exclusive of setæ, 0.8 mm. Greatest width (first free thorax segment), 0.175 mm. Length of anal setæ, 0.425 mm.

Color a uniform transparent white, the ovaries and digestive tube somewhat darker in color.

Male.—General form similar to that of the female with the following differences: Cephalon proportionally much longer and wider at its posterior end than any of the succeeding portions of the body. First free segment with a conspicuous indentation on either side near the anterior margin; anal setæ only one-third the length of the body.

First antennæ distinctly hinged, the second and fourth joints meeting on the anterior margin, both of them heavily armed with setæ and with a single large æsthetask at the distal end of the fourth joint; third joint seen only on the posterior margin and unarmed. Mouth parts and first legs like those of the female; second, third, and fourth legs with the endopods less distinctly segmented, the last two joints especially being often more or less fused, but with the number of setæ and spines practically the same and similarly arranged; fifth legs much smaller than in the female, reduced to a simple tiny process tipped with two short setæ.

Total length, 0.88 mm. Greatest width (posterior margin of the cephalon), 0.17 mm. Anal setæ, 0.33 mm. long.

Color like that of the female.

(*jamaicensis*, a native of Jamaica.)

These tiny copepods are common on the gills of the white land crab of Jamaica, nearly every specimen examined being infested with them. They cling to the gill filaments with their second antennæ and maxillipeds, but are dislodged much more easily than the Ergasilidæ or other small copepods that fasten similarly on the gill filaments of fishes. As many as 25 or 30 may sometimes be obtained from the gills of a single crab. In connection with their parasitism upon this host several extremely interesting questions arise which can not be finally settled without considerable further observation. But there

Digitized by Google

are certain facts already definitely known, and from these we may draw some conclusions:

1. The host is a land crab which lives for 11½ months out of the water, and only resorts to the ocean once a year for a week or 10 days, in order that its eggs may hatch into the customary free-swimming zœas. Hence while its gills are always necessarily moist enough to keep the copepod alive, there is no chance for the latter to do any swimming or to lay its own eggs except during this week or 10 days. This copepod therefore must be content with one breeding season a year, instead of the two or three which its kind ordinarily enjoy.

2. The copepod's eggs must be ripened and ready to push out into the external sac at the exact time that the crab's eggs are ready to hatch. Hence the extrusion of the copepod's eggs, their development into larvæ, the escape of the latter in the form of nauplii, their development through the various metanauplius and copepodid or cyclops stages to the adult form, and the fastening of the latter on the gills of a crab host must all be accomplished within the short period that the crabs remain in the ocean. If this be true, such a development is exceptionally rapid and is followed by a whole year of rest before the female can lay her first batch of eggs. If it is not true, the copepod remains a free swimmer during the first year of its existence and then becomes parasitic. It must thus lay its first batch of eggs while swimming about freely or wait two years for that occasion. In all the crabs captured before going into the ocean the female copepods were found to have their oviducts crowded with ripe eggs all ready for extrusion. On the contrary, not a single egg could be found in the oviducts of copepods taken from crabs that had come out of the ocean.

3. This copepod can not move around much on the crab's gills when the latter is out of the water, and no food can possibly be brought to it. Hence it must feed upon the blood in the gills, the slime that covers them, or something of the sort that can be obtained in sufficient abundance *in situ*. This means that it is parasitic and not commensal. The peculiar modification of the mandibles into a sort of proboscis or mouth tube and their sharp, toothed tips would corroborate such an inference.

4. It would naturally be supposed that such rigorous conditions could only be met by a copepod belonging to some thoroughly parasitic family, and we should look for considerable modification as the result of its degenerate habits. But what we really do find is as far removed from this as possible. *Cancrincola* belongs to a group, the Harpacticoida, which has always been considered to be typical free swimmers, and no member of the group has hitherto been known to live under any other conditions.

Digitized by Google

It is therefore remarkable that this single exception should depart so radically from the habits of its relatives. And then, in spite of the parasitism, it is still normally developed like all the other genera in the group and it has lost none of its ability to swim freely. Its life history, when fully worked out, ought to possess unusual interest.

PARASITIC OSTRACODS.

Very little is known with reference to the habits of the ostracods. The earlier authors like Linnæus, Geoffroy, Fabricius, O. F. Müller, Desmarest, and even Milne Edwards give a variety of details with regard to the different genera and species. But they are all content with a very few general observations on their habits and mode of life.

Baird (1850) was the first to give us any real knowledge of the food and activities of these entomostracans. But although he said that "most of the entomostraca are essentially carnivorous," and gave numerous examples of species which hunt and kill their prey, he made no mention of any ostracod that was parasitic.

In Brady's Report on the Ostracods of the *Challenger* Expedition nothing is said with regard to their food, but he mentions the fact that the Cypridinæ "appear to be most abundant in the warm surface waters of the tropical seas, contributing largely to the phosphorescence of those regions." He also calls attention to the fact that only the males can swim, the females lacking the rowing setæ on the antennæ, and in consequence living at the bottom in the sand or mud (p. 151).

G. W. Müller in his monograph on the Ostracods, which constitutes the twenty-first volume of the Fauna and Flora of the Bay of Naples, when speaking of their food, mentions finding diatom shells in the stomachs of some species, while he found one-celled algæ and the setæ of some small crustacea in the stomach of another species. A representative of the genus *Macrocypris*, kept in captivity, ate freely of small dead copepods, and *Conchœcia spinirostris* had in its stomach the apparent remains of copepods.

A young *Cypridina mediterranea*, while in captivity, ate greedily of a small dead annulate. Such observations as these suggest that a carnivorous ostracod might very well become parasitic under favorable conditions. It would not necessitate very much of a change in habits or structure.

And finally, in Lankester's Treatise on Zoology, Calman, who wrote the volume dealing with the Crustacea (1909), devotes only a few lines to the habits of the ostracods, in which he says: "None are definitely known to be parasitic, but one species found in the gill chambers of crayfish in North America may be so" (p. 67).

Digitized by Google

In view of these statements it will be of special interest to record the discovery of a new species of *Cypridina*, parasitic upon the gills of several kinds of fish.

That the presence of these ostracods on the fishes' gills was not accidental is abundantly proven by the following considerations: First there were too many of them; one or two or half a dozen might be washed on to the gills of a fish accidentally, but not 40 or 50. Again they were arranged altogether too regularly; in the space between the bases of two adjacent filaments and in contact with the gill arch, there was always a single ostracod, its long diameter at right angles to the gill arch, so that its anterior end projected slightly on one side between the filaments, and its posterior end on the other side.

Furthermore the tissues of each filament where they came in contact with the shell of the ostracod, were hollowed out in the center and slightly raised around the edges, thus forming a sort of pocket, which held the ostracod securely in place so that it could be removed only with a pair of forceps. This of course is absolute proof that the ostracod was not washed in temporarily, but that it had remained in position long enough to produce this effect on the tissues. In view of such conditions these ostracods may fairly be called parasitic. While it is impossible to see how they can draw any blood from the fish's gills, yet they certainly share the oxygenated water with which the fish keeps its gills supplied, and they get their food in some way while there. For food they may devour anything that the water contains and brings to them, they may eat scraps of the fish's food that come their way, or they may feed on the slime with which the fish's gills are covered. It is impossible to determine at present just what does constitute their diet.

CYPRIDINA PARASITICA, new species.

Plate 53.

Host and record of specimens.—Five lots of this ostracod were obtained in all; two of these were taken from the gills of two hammerhead sharks, *Sphyrna zygæna*, on July 9, and include about 50 specimens each. They have received the numbers 43581 and 43586, U.S.N.M., and become paratypes of the new species. The third lot contains a single specimen found on the gills of *Epinephelus adscensionis*, August 9, and is numbered 43599, U.S.N.M.

The fourth lot contains three specimens taken from the gills of a jack, *Caranx crysos*, August 1, and is numbered 43604, U.S.N.M. The fifth lot contains 12 specimens and was obtained from the nasal tubes of the hammer-head shark on June 17, and is numbered 43603, U.S.N.M.

Type-specimen.—Male, Cat. No. 43508, U.S.N.M., from one of the hammer-head sharks.

Digitized by Google

Male.—Shell subovate, greatest height posterior to the center, ventral and dorsal margins evenly rounded; posterior end formed by the continued even sweep of the dorsal margin, but with the lower portion protruding somewhat as in *C. mediterranea*. Antennal sinus narrow and not very deep, with parallel sides; rostrate process wide, well arched anteriorly, acute at the point and directed downward and slightly backward. Eye large and at about the center of the shell dorso-ventrally but considerably in frontof the antero-posterior center. Length of shell, 1.8 mm.; height, 1.15 mm.

Antennules rather stout; terminal joint with three long setæ of equal length; sensory appendage on the fifth joint long, distinctly ringed and divided at the tip, its secondary filaments short and flattened. Antennæ of the usual form, swimming branch bearing nine setæ, the basal one much shorter than the others; appendicular branch witha very short basal seta and a long and stout terminal one, carrying a short secondary seta on its inner margin. Hirsute masticatory lobe of the mandibles large and prominent; basal joint of the palp considerably swollen; subterminal joint about half the entire length, terminal claws stout and of the same size.

First maxilla broad and stout, with a long and slender palp, thickly armed with setæ at its tip; second maxilla rather slender with broad and flattened setæ; vibratory lamina narrow, its setæ increasing in length from the tip toward the base; third maxilla wide and stout, vibratory lamina broadly triangular and armed with two long setæ at the outer corner and six shorter ones along the basal portion of the anterior margin, with a considerable space between the two devoid of armature. Vermiform leg armed with 10 to 12 very slender cilia along either margin and one or two at the end. Caudal lamina with 14 spines, gradually increasing in length from the base toward the tip, the last three much shorter than the others and of nearly the same length.

Female unknown.

LIST OF HOSTS, WITH PARASITES FOUND ON EACH.

SPHYRNA ZYGÆNA. Hammerhead shark.

Ergasilus nyctarothes Wilson, living in the nasal tubes.
Tæniacanthus flagellans Wilson, from the gill cavities close to the edge of the gill filaments.
Lepeophtheirus longiepinosus Wilson, from the inside of the gill cavity.
Nemesis versicolor Wilson, attached to the gill filaments.
Cypridina parasitica Wilson, the ostracod, between the gill filaments at their base.

DASYATIS HASTATA. Sting ray.

Brachiella concava Wilson, from the gill arches.

HEMIRAMPHUS BRASILIENSIS. Balao.

Lernæolophus hemiramphi Krøyer, from the mouth opening.

EXOCŒTUS VOLITANS. Flying fish.

Pennella exocœti (Holten), with its head and anterior body buried in the flesh along the side of the fishs' body.

Digitized by Google

SPHYRÆNA BARRACUDA. The barracuda.
Caligus productus Dana, from the outside of the body.
Caligus isonyx Steenstrup and Lütken, from the gills.
Midias lobodes Wilson, from the outside of the body and head.
Lernæolophus striatus Wilson, from the inside of the throat.

CARANX HIPPOS. The jack.
Caligus tenax Heller, attached to the gill filaments.
Lernanthropus giganteus Krøyer, attached to the gill filaments and arches.

CARANX CRYSOS. The yellow jack.
Pseudocucanthus uniseriatus Wilson, from the gills and mouth cavity.
Caligus tenax Heller, from the mouth.
Caligus robustus Bassett-Smith, from the gill filaments.
Lernanthropus giganteus Krøyer, from the gills.
Cypridina parasitica Wilson, the ostracod, between the gill filaments at their base.

CORYPHÆNA HIPPURUS. The dolphin.
Caligus productus Dana, from the outside surface of the body.
Eurypborus coryphænæ Krøyer, from the gills.

EPINEPHELUS ADSCENSIONIS. The rock hind.
Sagum flagellatum, a new genus and species, attached to the gill arch.
Hatschekia insolita Wilson, fastened to the outside of the gill filaments.
Hatschekia uncata Wilson, fastened between the gill filaments at their base.

EPINEPHELUS MORIO. The red grouper.
Lepeophtheirus dissimulatus Wilson, from the outside surface.

MYCTEROPERCA VENENOSA APUA. The cardenal or poison grouper.
Dentigryps curtus, a new genus and species, found in the mouth and gill cavities.

SERRANUS (species not given).
Lernanthropus angulatus Krøyer, found on the gills.
Therodamas serrani Krøyer, also from the gills.

NEOMÆNIS AYA. The red snapper.
Caligus irritans Heller, from the gill filaments.
Paralebion curticaudis Wilson, from the gill arches.
Lernanthropus frondeus Wilson, from the gill filaments.
Hatschekia oblonga Wilson, also from the gill filaments.
Thysanote longimana Wilson, from the outside of the throat.

NEOMÆNIS SYNAGRIS. The lane snapper.
Lernanthropus spiculatus Wilson and *Hatschekia albirubra* Wilson, both from the gill filaments.

HÆMULON SCIURUS. The yellow grunt.
Caligus hæmulonis Krøyer, from the gills.

OCYURUS CHRYSURUS. The yellow-tail.
Lernanthropus obscurus Wilson, and *Hatschekia albirubra* Wilson, both from the gill filaments.

BATHYSTOMA RIMATOR. The red-mouthed grunt.
Caligus robustus Bassett-Smith, from the gills.
Hatschekia linearis Wilson, also from the gills.
Clavella inversa Wilson, from the gill cavity.

ABUDEFDUF SAXATILIS. The sheepshead.
Bomolochus nothrus Wilson, from the gill cavity.

SPARISOMA VIRIDE. The green parrot-fish.
Caligus furcatus Wilson, fastened in the spaces between adjacent filaments.
Caligus enormis Wilson, clinging to the inside of the gill filaments.

SCARUS CŒRULEUS. The blue parrot-fish.
Caligus suffuscus Wilson, from the mouth cavity.
Lernæolophus recurvus Wilson, fastened to the gill arches.

HARPE RUFA. The Spanish lady-fish.
Lepeophtheirus cosyphi Krøyer, from the gills.

POMACANTHUS ARCUATUS. The black angel-fish.
Anuretes parvulus Wilson, from the gill filaments.

TEUTHIS HEPATUS. The doctor-fish.
Caligus atromaculatus Wilson from the gills.
Hatschekia linearis Wilson, attached to the gill filaments.
Clavella laciniata Krøyer, from the skin of the roof of the mouth.

BALISTES VETULA. The trigger-fish.
Caligus productus Dana, from the outside surface of the body.
Caligus ballistæ Steenstrup and Lütken, from the mouth cavity and the fins.

Digitized by Google

POMACANTHUS PARU. The Indian or flat-fish.
Thysanote pomacanthi Krøyer, from the gills.

MONACANTHUS HISPIDUS. The file-fish.
Caligus monacanthi Krøyer, from the outside skin.

ALEUTERA SCRIPTA. The tobacco-fish.
Bomolochus nothrus Wilson, from the gill filaments.

SPHEROIDES MARMORATUS. The spiny-backed puffer.
Tucca impressus Krøyer, from the pectoral fins.

DIODON HYSTRIX. The porcupine-fish.
Tucca impressus Krøyer, from the pectoral fins.
Hatschekia iridescens Wilson, from the gill filaments.

CHILOMYCTERUS ANTENNATUS. The spiny puffer.
Ergasilus longipalpus Wilson, from the gill filaments.
Tucca impressus Krøyer, from the pectoral fins.

SCORPÆNA PLUMIERI. The scorpion-fish.
Bomolochus attenuatus Wilson, and *Artacolax palleucus* Wilson, both attached to the gill filaments.

CARDISOMA GUANHUMI. The white land crab.
Cancrincola jamaicensis, a new genus and species, from the gills.

EXPLANATION OF PLATES.

PLATE 18.

Females of *Ergasilus longipalpus*, and *Ergasilus myctarothes*.

Fig. 1. Dorsal view of *E. longipalpus*. Fig. 2. Mouth parts; *md*, mandibles; *mx* 1 and *mx* 2, first and second maxillæ. Figs. 3 to 6. First, second, third, and fourth swimming legs. Fig. 7. Dorsal view of *E. myctarothes*. Fig. 8. Mouth parts. Fig. 9. Ventral view of abdomen. Figs. 10 to 12. First, third, and fourth swimming legs.

PLATE 19.

Male and female of *Bomolochus nothrus*.

Fig. 13. Dorsal view of female. Fig. 14. Second antenna. Fig. 15. Mouth parts; *lb*, upper lip; *md*, mandible; *mx* 1 and *mx* 2, first and second maxillæ; *mxp*, maxilliped. Figs. 16 to 20. First, second, third, fourth, and fifth swimming legs. Fig. 21. One of the claws on the exopods of the legs of the male.

PLATE 20.

Male of *Bomolochus nothrus*.

Fig. 22. Dorsal view. Fig. 23. Mouth parts; *an*^{2}, second antennæ, other lettering as before. Figs. 24 to 27. First, second, third, and fourth swimming legs.

PLATE 21.

Female of *Bomolochus attenuatus*.

Fig. 28. Dorsal view. Fig. 29. Second antenna. Fig. 30. Mouth parts, lettering as in fig. 15. Figs. 31 to 34. First, second, third, and fourth swimming legs.

PLATE 22.

Male and female of *Artacolax palleucus*,.

Fig. 35. Dorsal view of male. Figs. 36 to 38. First, third, and fourth swimming legs. Fig. 39. Dorsal view of female. Figs. 40 and 41. First and second swimming legs.

Digitized by Google

PLATE 23.

Mouth parts and swimming legs of *Artacolax palleucus*.

Figs. 42 and 43. Third and fourth swimming legs of female. Fig. 44. Mouth parts of female. Fig. 45. Mouth parts of male. (For lettering, see fig. 15.)

PLATE 24.

Female of *Pseudocucanthus uniseriatus*.

Fig. 46. Dorsal view of female. Fig. 47. Second antenna. Fig. 48. Mouth parts. Figs. 49 to 53. First, second, third, fourth, and fifth swimming legs.

PLATE 25.

Female of *Tæniacanthus flagellans*, and leg of *Caligus irritans*.

Fig. 54. Dorsal view of female. Fig. 55. First antenna. Fig. 56. Mouth parts. (For lettering, see fig. 15.) Figs. 57 to 60. First, second, third, and fourth swimming legs. Fig. 61. Side view of female, showing how the cephalon projects at right angles to the rest of the body. Fig. 62. Fourth leg of *Caligus irritans*.

PLATE 26.

Female of *Caligus tenax*.

Fig. 63. Dorsal view. Fig. 64. Second antennæ and maxillary hooks. Fig. 65. Maxilliped. Figs. 66 to 69. First, second, third, and fourth swimming legs. Fig. 70. Second antenna and maxillary hook of male. (For lettering, see fig. 15.)

PLATE 27.

Male and female of *Caligus irritans*.

Fig. 71. Dorsal view of male. Fig. 72. Second antenna, maxillary hook, maxilla maxilliped, and furca of male. Fig. 73. Dorsal view of female. Fig. 74. Second antenna, maxillary hook, first maxilla, and mouth tube of female. Fig. 75. Maxilliped. Fig. 76. Furca. Figs. 77 to 79. First, second, and third swimming legs. Fig. 80. Cement glands, ventral view.

PLATE 28.

Male and female of *Caligus robustus*.

Fig. 81. Dorsal view of female. Fig. 82. Second antenna, maxillary hook, and first maxilla. Fig. 83. Furca. Fig. 84. Maxilliped. Figs. 85 to 88. First, second, third, and fourth swimming legs. Fig. 89. Dorsal view of male. Fig. 90. Maxilliped. Fig. 91. Fourth swimming leg.

PLATE 29.

Female of *Caligus atromaculatus*, and male and female of *Caligus tenax*.

Fig. 92. Dorsal view of female of *C. atromaculatus*. Fig. 93. Second antenna and first maxilla. Fig. 94. Maxilliped. Fig. 95. Furca. Figs. 96 to 98. First, second, and fourth swimming legs. Fig. 99. Dorsal view of male of *C. tenax*. Fig. 100. Furca. Fig. 101. Cement glands of female *C. tenax*.

69077°—Proc.N.M.vol.44—13——18

Digitized by Google

PLATE 30.

Females of *Caligus afurcatus*, and *C. suffuscus*.

Fig. 102. Dorsal view of female of *C. afurcatus*. Fig. 103. Second antenna, maxillary hook, and first maxilla. Fig. 104. Maxilliped. Fig. 105. Third swimming leg. Fig. 106. Cement glands. Fig. 107. Dorsal view of female of *C. suffuscus*. Fig. 108. Second antenna and maxillary hook. Fig. 109. First maxilla. Fig. 110. Maxilliped. Fig. 111. Furca. Figs. 112 to 115. First, second, third, and fourth swimming legs.

PLATE 31.

Male and female of *Caligus enormis*.

Fig. 116. Dorsal view of female. Fig. 117. Second antenna and maxillary hook. Fig. 118. First and second maxillæ and mouth tube. Figs. 119 to 122. First, second, third, and fourth swimming legs. Fig. 123. Dorsal view of male. Fig. 124. Second antenna and maxillary hook. Fig. 125. Maxilliped of male. Fig. 126. Maxilliped of female.

PLATE 32.

Female of *Dentigryps curtus*, and swimming legs of *Caligus afurcatus*.

Fig. 127. Dorsal view of female of *Dentigryps curtus*. Fig. 128. Second antenna and maxillary hook. Fig. 129. Mouth tube and first maxilla. Fig. 130. Maxilliped. Fig. 131. Furca. Figs. 132 to 134. First, third, and fourth swimming legs. Fig. 135. Ventral view of posterior end of genital segment and abdomen. Figs. 136 to 138. First, second, and fourth swimming legs of *Caligus afurcatus*.

PLATE 33.

Female of *Anuretes parvulus*, and of *Lernanthropus giganteus*.

Fig. 139. Dorsal view of *Anuretes parvulus*. Fig. 140. First antenna. Fig. 141. Second antenna. Fig. 142. First maxilla and mouth tube. Fig. 143. Maxilliped. Figs. 144 to 146. First, second, and third swimming legs. Fig. 147. Ventral view of genital segment and abdomen. Fig. 148. Ventral view of cephalothorax of female *Lernanthropus giganteus*. Fig. 149. Ventral view of genital segment and abdomen of same, showing fifth leg and attachment of spermatophore (*sp.*). Fig. 150. Same view of another specimen, showing irregular arrangement of eggs.

PLATE 34.

Female of *Paralebion curticaudis*.

Fig. 151. Dorsal view. Fig. 152. Second antenna, maxillary hook and first maxilla. Fig. 153. Second maxilla. Fig. 154. Maxilliped. Fig. 155. Furca. Figs. 156 to 159. First, second, third, and fourth swimming legs. Fig. 160. Ventral view of genital segment, showing cement glands. Fig. 161. Posterior lobe of genital segment, showing fifth leg and origin of egg-tube.

PLATE 35.

Male and female of *Lernanthropus giganteus*.

Fig. 162. Dorsal view of female. Figs. 163 and 164. First and second swimming legs. Fig. 165. Dorsal view of male. Fig. 166. Second antennæ. Fig. 167. Mouth tube, maxillæ, maxilliped, and first and second swimming legs of male.

Digitized by Google

PLATE 36.

Male and female of *Lernanthropus frondeus.*

Fig. 168. Dorsal view of female. Fig. 169. Second antenna. Fig. 170. Mouth tube and first maxillæ. Fig. 171. Maxilliped. Fig. 172. Ventral view of genital segment and abdomen, showing leaf-like fifth legs and anal laminæ. Figs. 173 and 174. First and second swimming legs. Fig. 175. Dorsal view of male. Fig. 176. First antenna. Fig. 177. Maxilliped.

PLATE 37.

Male and female of *Lernanthropus obscurus.*

Fig. 178. Dorsal view of female. Fig. 179. Second antenna. Figs. 180 and 181. First and second swimming legs. Fig. 182. Dorsal view of male. Fig. 183. Mouth tube, mouth parts, and swimming legs of female. (*m*, mouth; 1, first swimming leg; 2, second swimming leg. For other lettering see fig. 15.) Fig. 184. Same of male. (For lettering see fig. 183.)

PLATE 38.

Female of *Lernanthropus spiculatus* new species, and *Nemesis versicolor.*

Fig. 185. Dorsal view. Fig. 186. Second antenna. Fig. 187. Mouth tube and first and second maxillæ. Fig. 188. Maxilliped. Fig. 189. Ventral view, showing swimming legs. Fig. 190. Second antenna of *Nemesis versicolor.* Figs. 191 to 194. First, second, third, and fourth swimming legs of same.

PLATE 39.

Female of *Sagum flagellatum.*

Fig. 195. Dorsal view. Fig. 196. Ventral view. Fig. 197. First and second antennæ, mouth parts, and swimming legs, enlarged. (an^1, first antenna; an^2, second antenna; 1, first swimming leg; 2, second swimming leg; other lettering as before.) Fig. 198. One of the fourth swimming legs, showing structure. Fig. 199. Ventral view genital segment and abdomen.

PLATE 40.

Male and female of *Nemesis versicolor.*

Fig. 200. Dorsal view of female. Fig. 201. Second maxilla. Fig. 202. Dorsal view of male. Fig. 203. First and second antennæ. Fig. 204. First and second maxillæ and maxilliped. Fig. 205 to 208. First, second, third, and fourth swimming legs.

PLATE 41.

Female of *Hatschekia albirubra*, and *H. iridescens.*

Fig. 209. Dorsal view of female of *H. albirubra.* Fig. 210. First antenna. Fig. 211. Second antenna. Fig. 212. First maxilla. Fig. 213. Maxilliped. Figs. 214 and 215. First and second swimming legs. Fig. 216. Nauplius of *H. iridescens.* Fig. 217. First antenna of female *H. iridescens.* Fig. 218. Mouth tube and maxilla. Fig. 219. Maxilliped. Figs. 220 and 221. First and second swimming legs.

PLATE 42.

Females of *Hatschekia oblonga*, and of *H. insolita.*

Fig. 222. Dorsal view of female *H. oblonga.* Fig. 223. Second antenna. Fig. 224. Maxilliped. Figs. 225 and 226. First and second swimming legs. Fig. 227. Dorsal view of female *H. insolita.* Fig. 228. Second antenna. Fig. 229. Mouth tube and first maxillæ. Fig. 230. Maxilliped. Figs. 231 and 232. First and second swimming legs.

Digitized by Google

PLATE 43.

Female of *Hatschekia uncata*.

Fig. 233. Dorsal view of female. Fig. 234. Second antenna. Fig. 235. Maxilliped. Fig. 236. Mouth tube and maxillæ. Figs. 237 and 238. First and second swimming legs. Fig. 239. Fused genital segment and abdomen.

PLATE 44.

Female of *Hatschekia linearis*, and male of *H. iridescens*.

Fig. 240. Dorsal view of female of *H. linearis*. Fig. 241. First antennæ. Fig. 242. Maxilla and maxilliped. Fig. 243. Second antenna. Figs. 244 and 245. First and second swimming legs. Fig. 246. Ventral view, showing oviducts, cement glands, and fused genital segment and abdomen. Fig. 247. Dorsal view of male *H. iridescens*.

PLATE 45.

Female of *Hatschekia iridescens*.

Fig. 248. Dorsal view of female. Fig. 249. First antenna of male. Fig. 250. Second antenna of female. Fig. 251. Second antenna of male. Fig. 252. Maxilliped of female. Figs. 253 and 254. First and second swimming legs of male. Fig. 255. Ventral view of female, showing cement glands (*c. g.*), oviducts (*ov.*), spermatophore (*sp.*), and sperm receptacle (*s. r.*).

PLATE 46.

Female of *Lernæolophus recurvus*.

Fig. 256. Side view of young female. Fig. 257. Ventral view of head and upper portion of thorax, showing mouth parts and swimming legs. (*la*, underlip; other lettering as before.) Fig. 258. Diagonal view of head and mouth parts. (Lettering as before.) Fig. 259. Side view of adult female, showing branched processes and the densely matted dichotomous processes of the abdomen.

PLATE 47.

Female of *Lernæolophus striatus*, and *Thysanote longimana*.

Fig. 260. Dorsal view of *L. striatus*. Fig. 261. Ventral view of cephalothorax, showing mouth parts and swimming legs. (Lettering as before.) Fig. 262. Side view of male of *T. longimana*, showing antennæ and mouth parts. (Lettering as before.) Fig. 263. Second antenna of female. Fig. 264. Maxilliped of female.

PLATE 48.

Male and female of *Thysanote longimana*.

Fig. 265. Dorsal view of female. Fig. 266. Ventral view of head, showing mouth tube and maxillæ. Fig. 267. First antenna. Fig. 268. Maxilla. Fig. 269. Side view of male.

PLATE 49.

Male and female of *Clavella laciniata*

Fig. 270. Side view of female. Fig. 271. Second antenna. Fig. 272. Maxilla. Fig. 273. Maxilliped. Fig. 274. Side view of male.

Digitized by Google

PLATE 50.

Female of *Clavella inversa*, and male of *Cancrincola jamaicensis*.

Fig. 275. Side view of female. Fig. 276. Front view of cephalothorax, showing mouth tube and mouth parts (above), and second maxillæ (below). Fig. 277. Base of second maxillæ, enlarged, showing maxillary glands. Fig. 278. Ventral view of head. (Lettering as before.) Fig. 279. Maxilla. Fig. 280. Maxilliped. Fig. 281. Fourth swimming leg of male of *Cancrincola jamaicensis*, new genus and species.

PLATE 51.

Cancrincola jamaicensis, and female of *Brachiella concava*.

Figs. 282 and 283. Third swimming leg of male and fifth swimming leg of female, *Cancrincola jamaicensis*. Fig. 284. Side view of female *Brachiella concava*. Fig. 285. Dorsal view of genital segment of same, showing posterior processes. Figs. 286 and 287. Side and ventral views of anterior part of head, showing antennæ and mouth parts. (Lettering as before.) Fig. 288. Maxilliped.

PLATE 52.

Male and female of *Cancrincola jamaicensis*.

Fig. 289. Dorsal view of male. Fig. 290. First antenna. Fig. 291. Fifth swimming leg. Fig. 292. Dorsal view of female. Fig. 293. First antenna. Fig. 294. Second antenna. Fig. 295. Mandible. Fig. 296. First maxilla. Fig. 297. Second maxilla. Fig. 298. Maxilliped. Figs. 299 to 302. First, second, third, and fourth swimming legs.

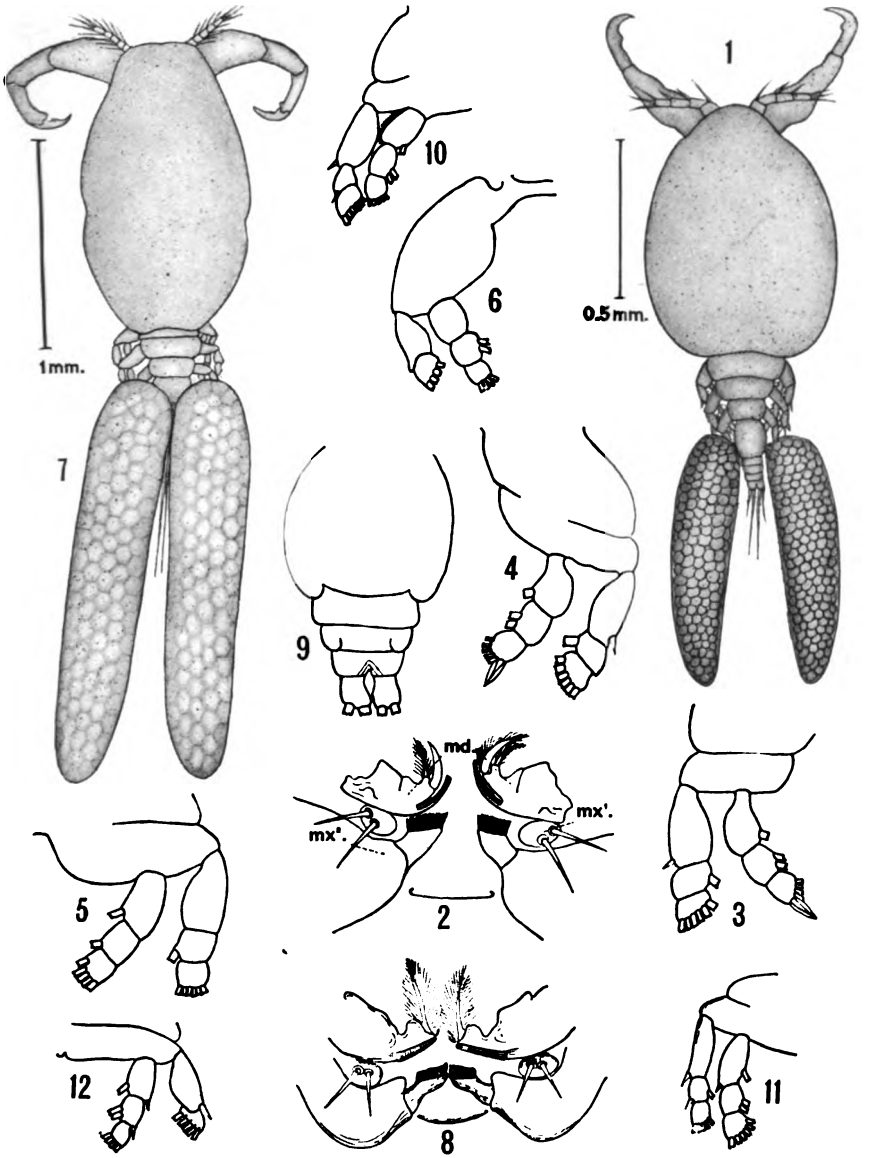
PLATE 53.

Male of *Cypridina parasitica*.

Fig. 303. Side view of male. Fig. 304. First antenna. Figs. 305 and 306. Second antenna, dorsal and ventral views. Fig. 307. Mandible. Fig. 308. First maxilla. Fig. 309. Second maxilla. Fig. 310. Third maxilla. Fig. 311. Vermiform swimming leg, and caudal lamina.

Digitized by Google

Digitized by Google

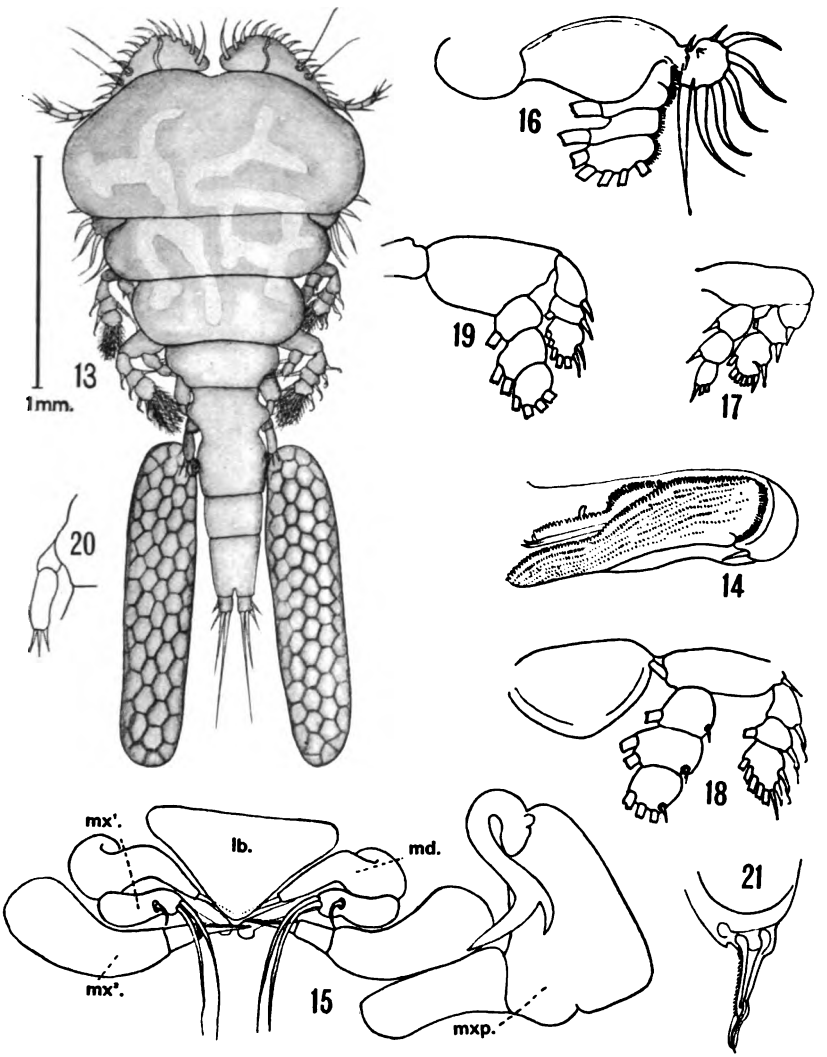


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 272.

Digitized by Google

Digitized by Google

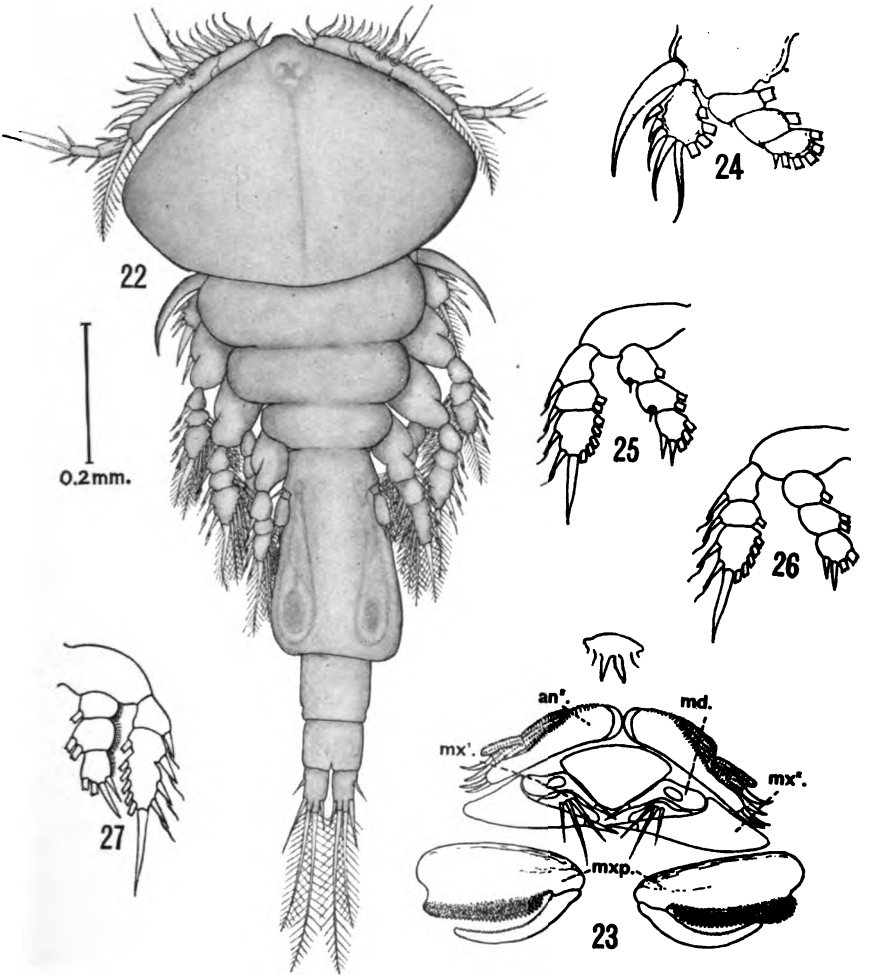


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 272.

Digitized by Google

Digitized by Google

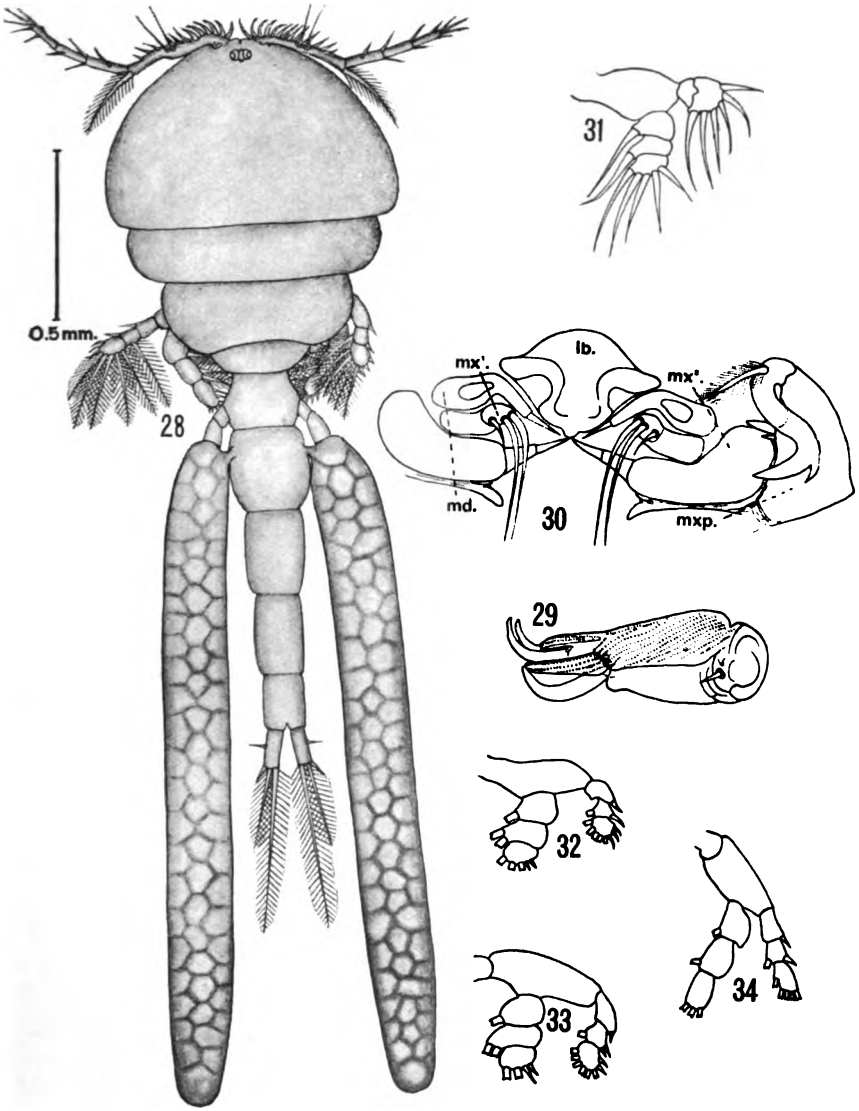


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 272.

Digitized by Google

Digitized by Google

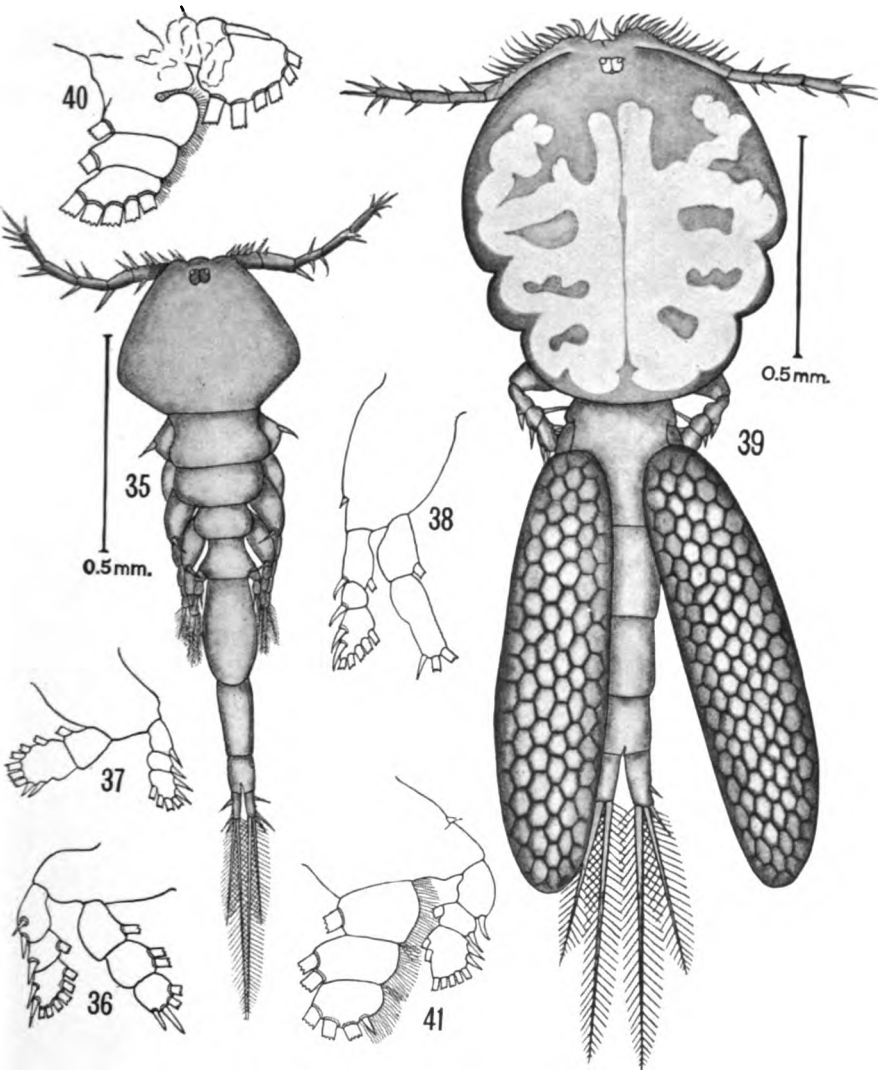


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 272.

Digitized by Google

Digitized by Google

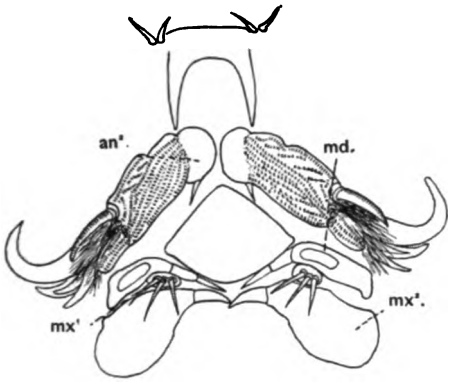


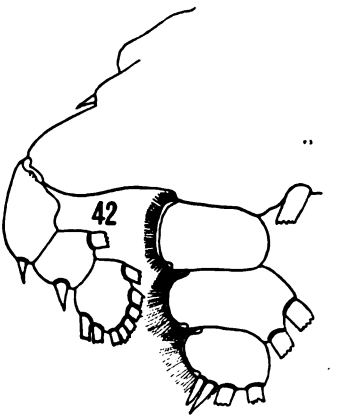
CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

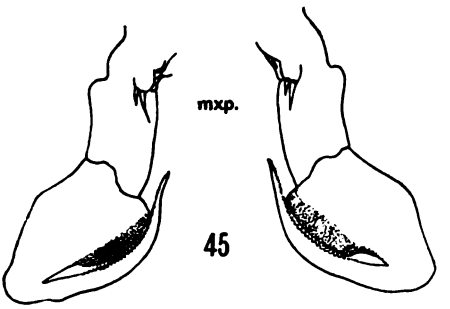
FOR EXPLANATION OF PLATE SEE PAGE 272.

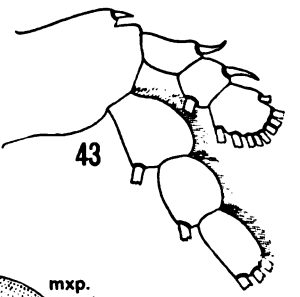
Digitized by Google

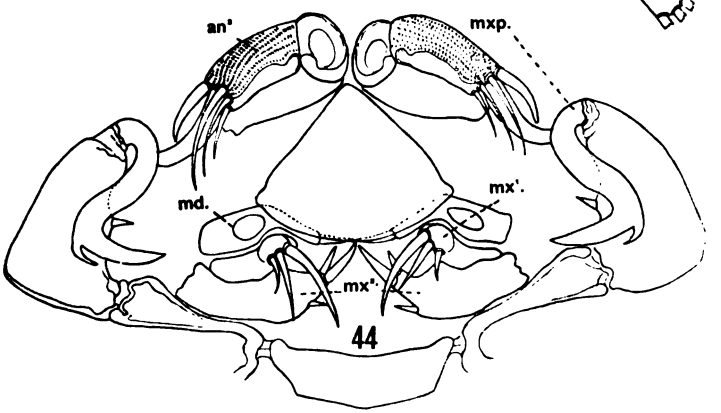
Digitized by Google









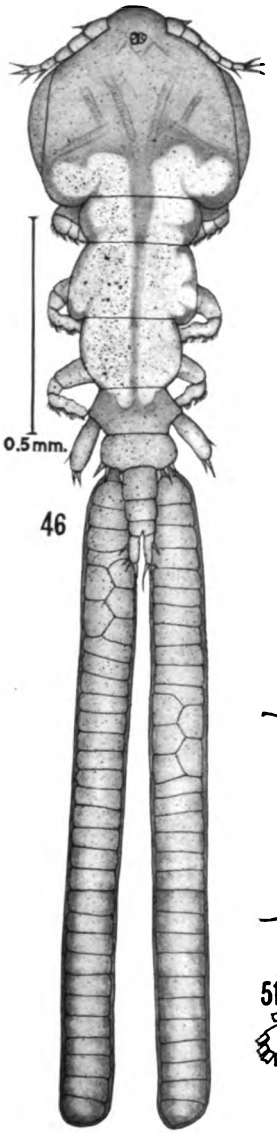


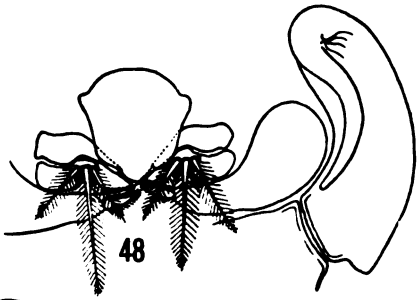
CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

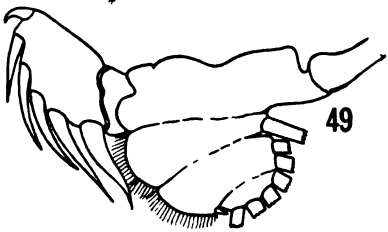
FOR EXPLANATION OF PLATE SEE PAGE 273.

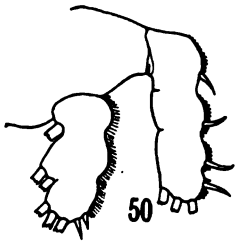
Digitized by Google

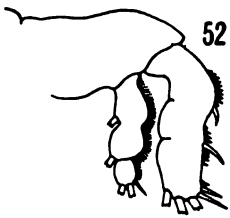
Digitized by Google

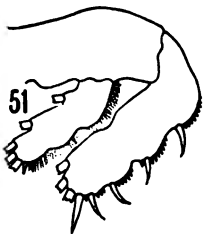










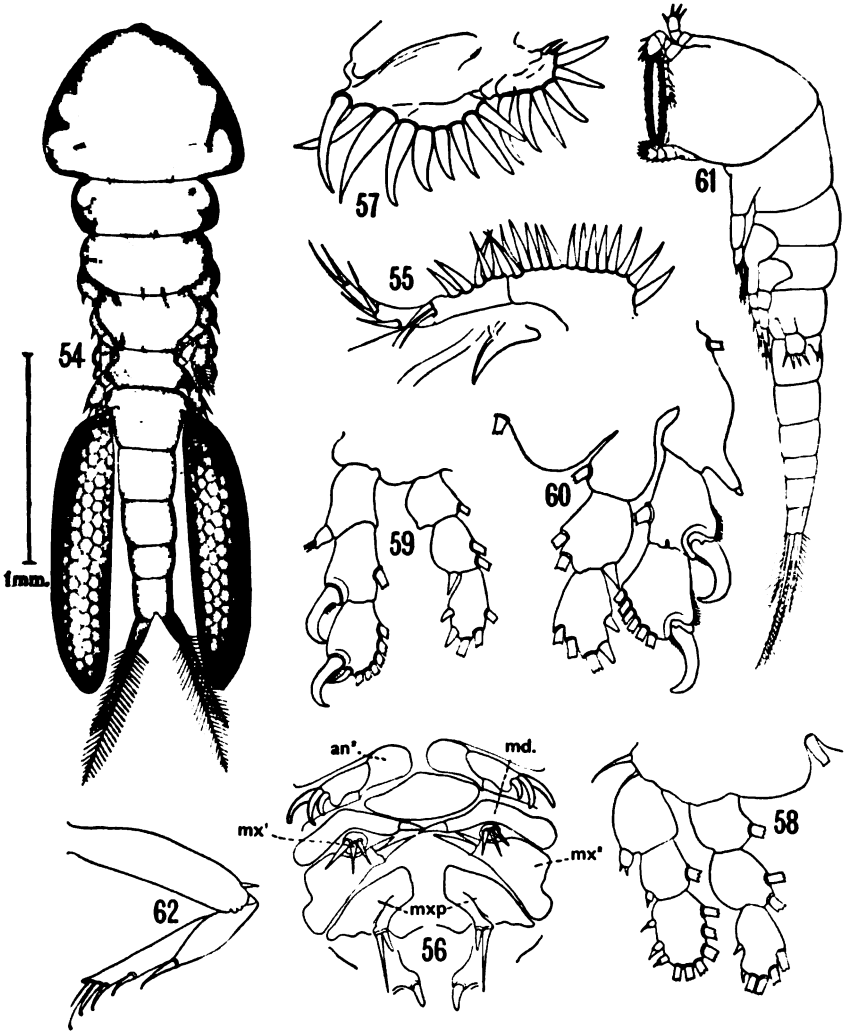


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 273.

Digitized by Google

Digitized by Google

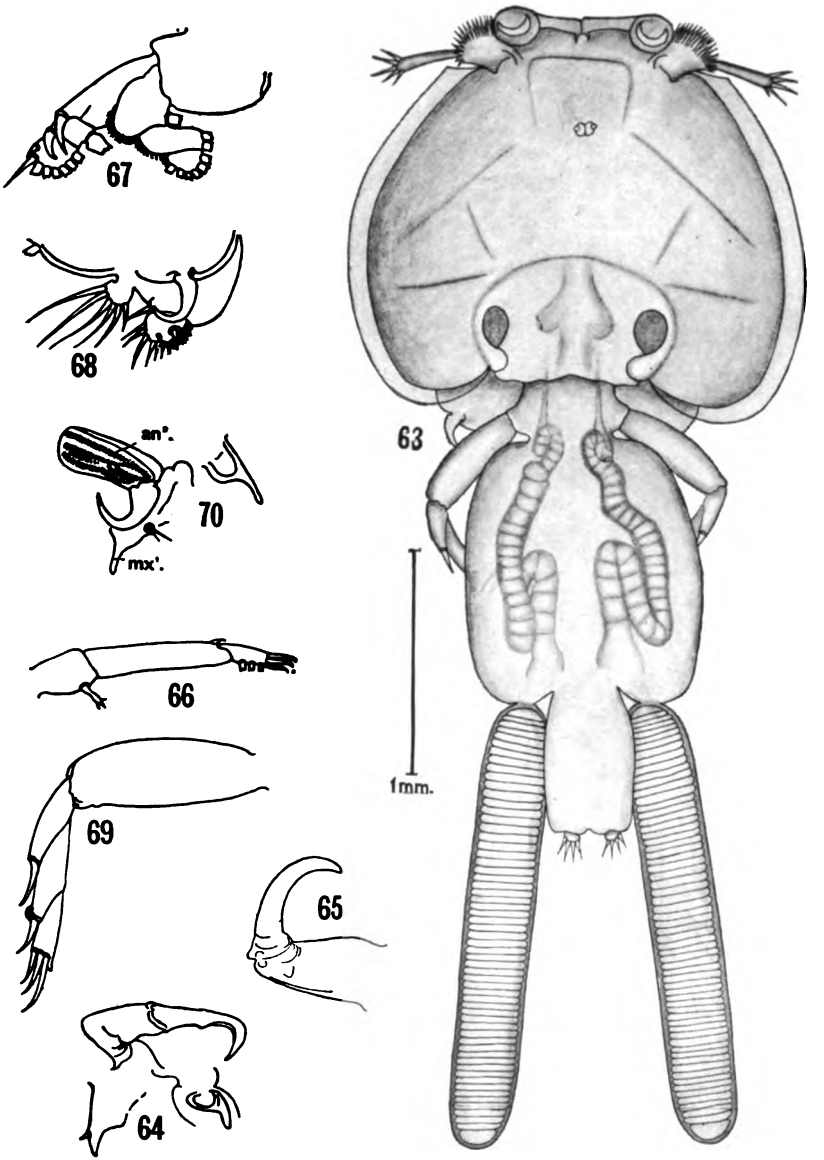


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 273.

Digitized by Google

Digitized by Google

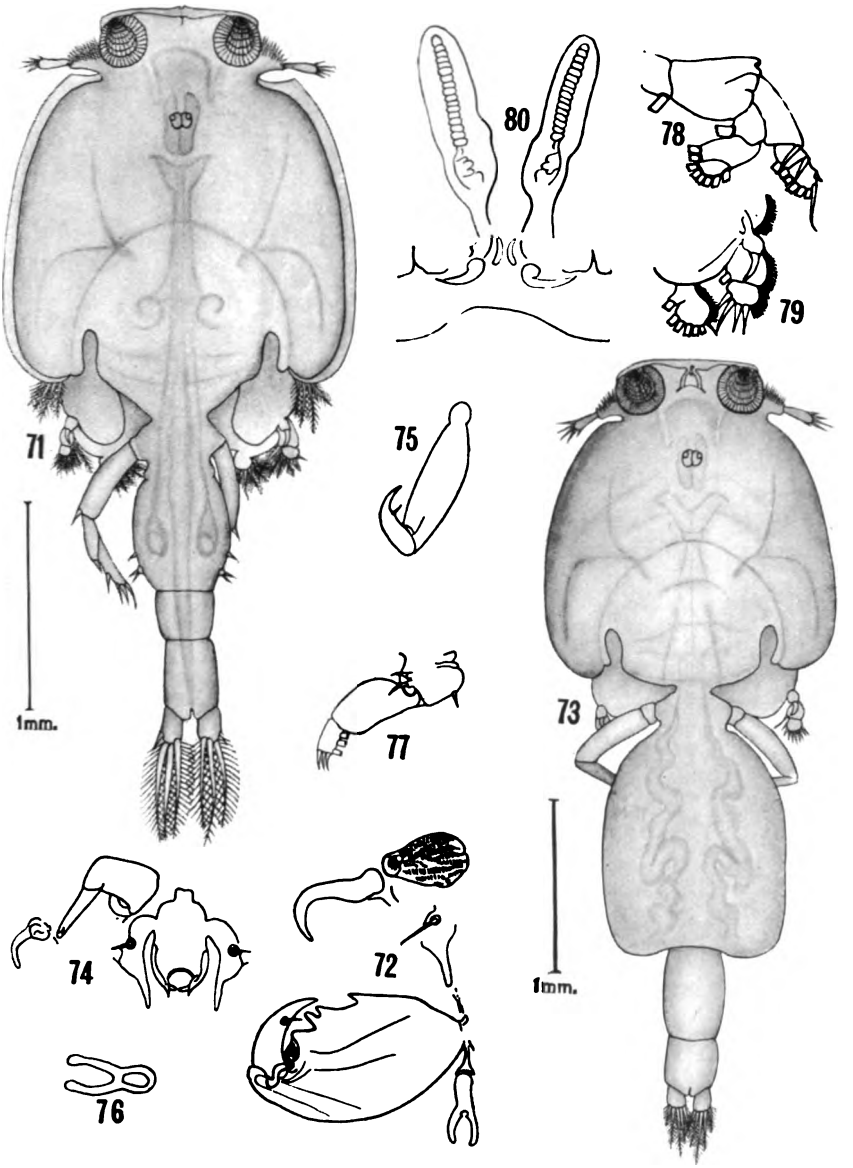


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 273.

Digitized by Google

Digitized by Google

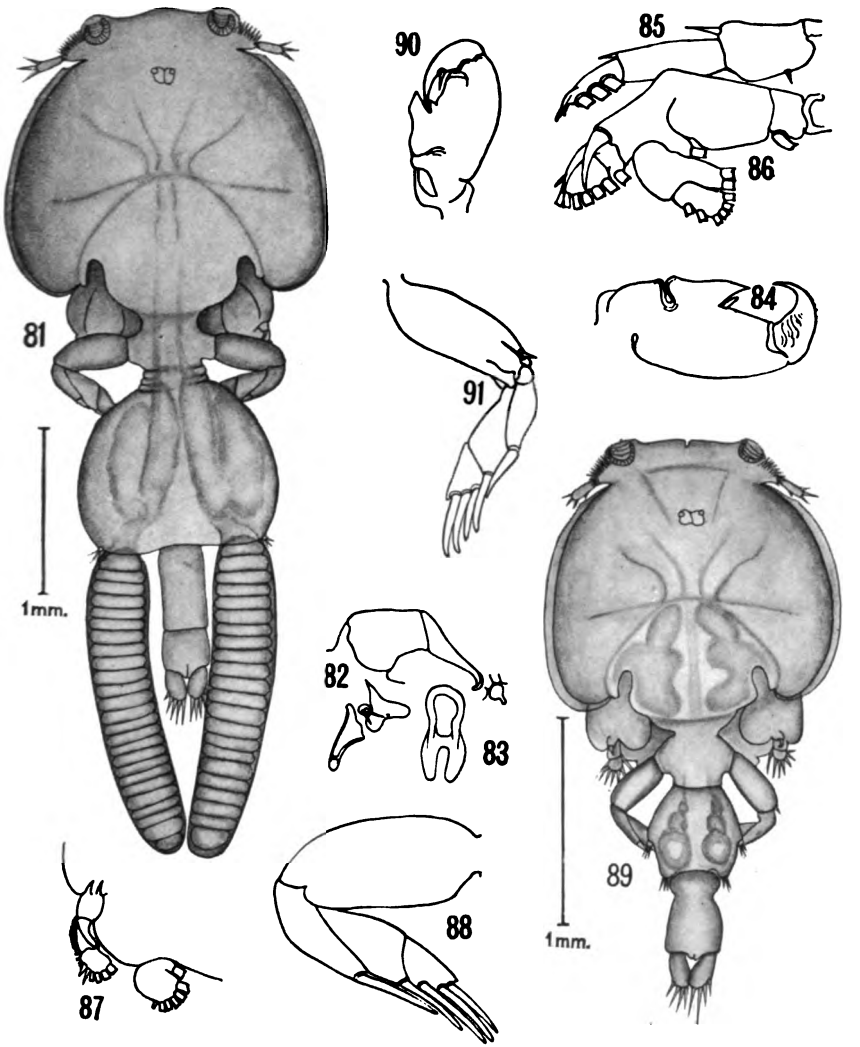


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 273.

Digitized by Google

Digitized by Google

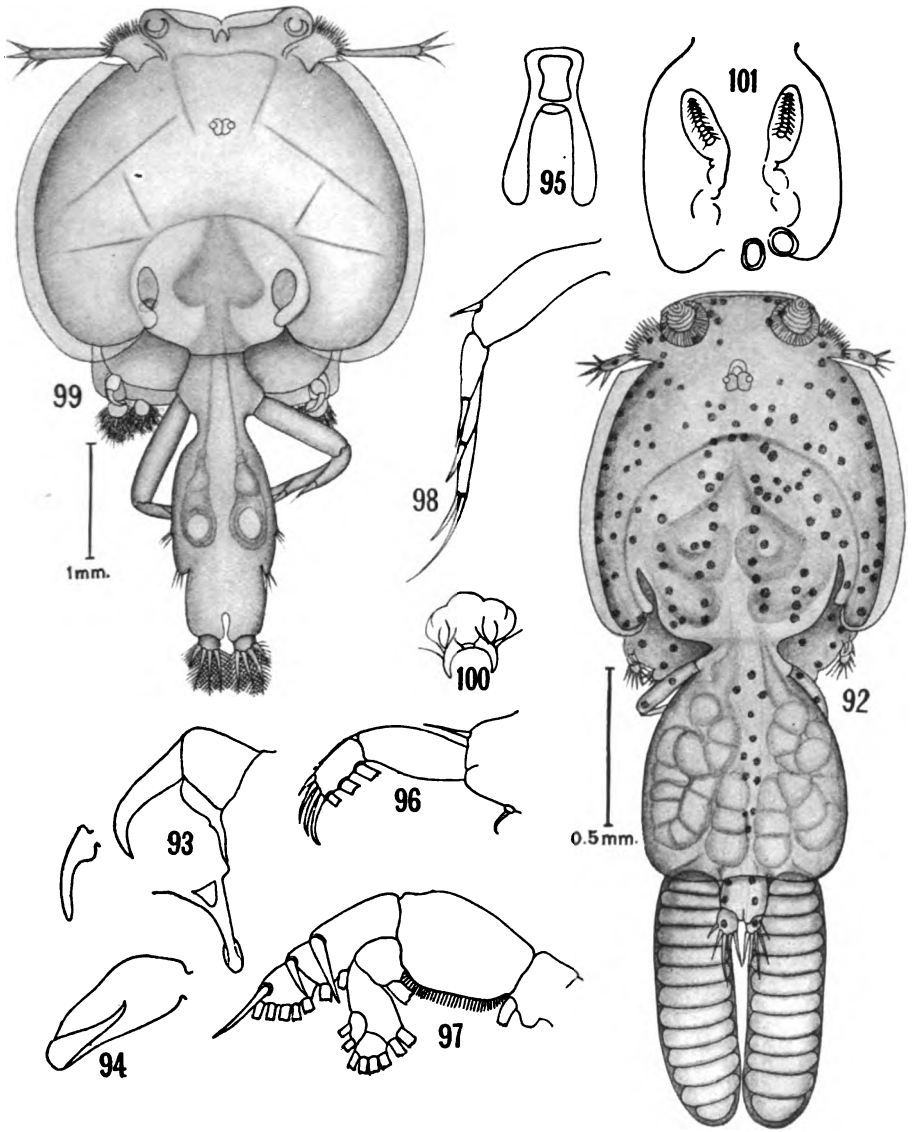


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 273.

Digitized by Google

Digitized by Google

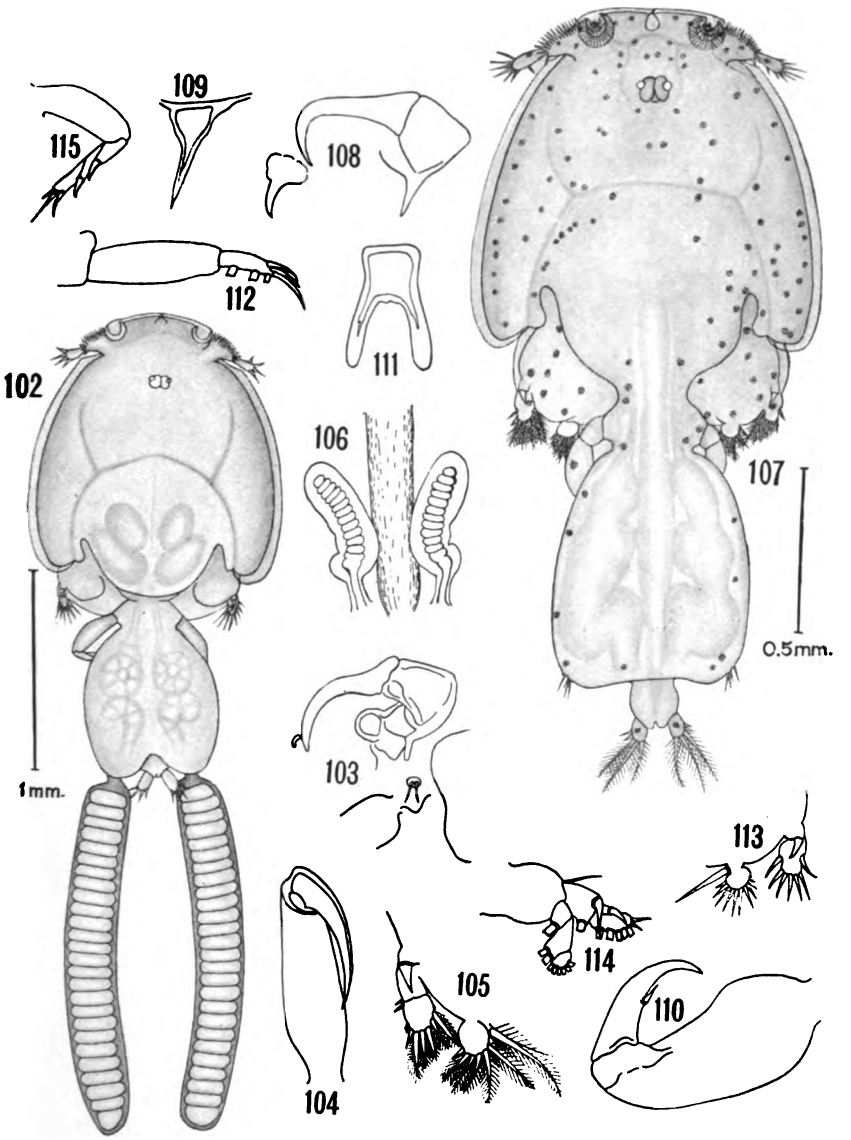


CRUSTACEAN PARASITES OF WEST INDIAN FISHES

FOR EXPLANATION OF PLATE SEE PAGE 273.

Digitized by Google

Digitized by Google

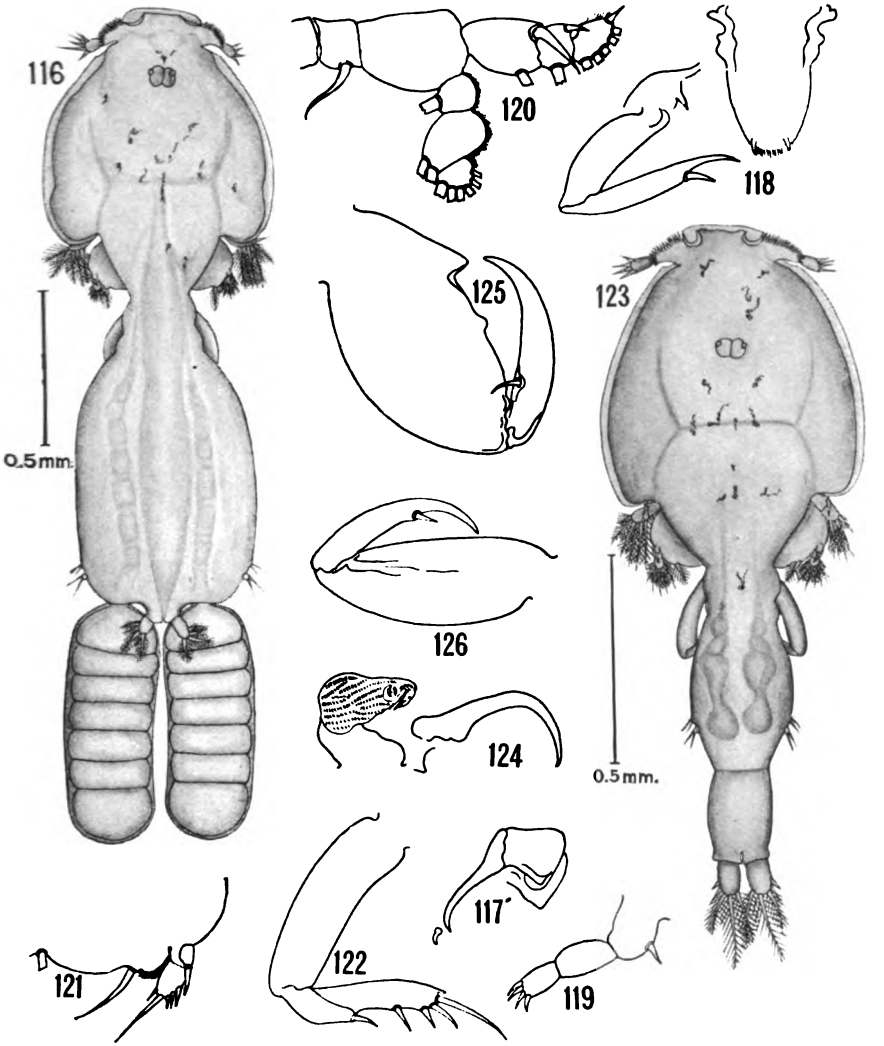


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 274.

Digitized by Google

Digitized by Google

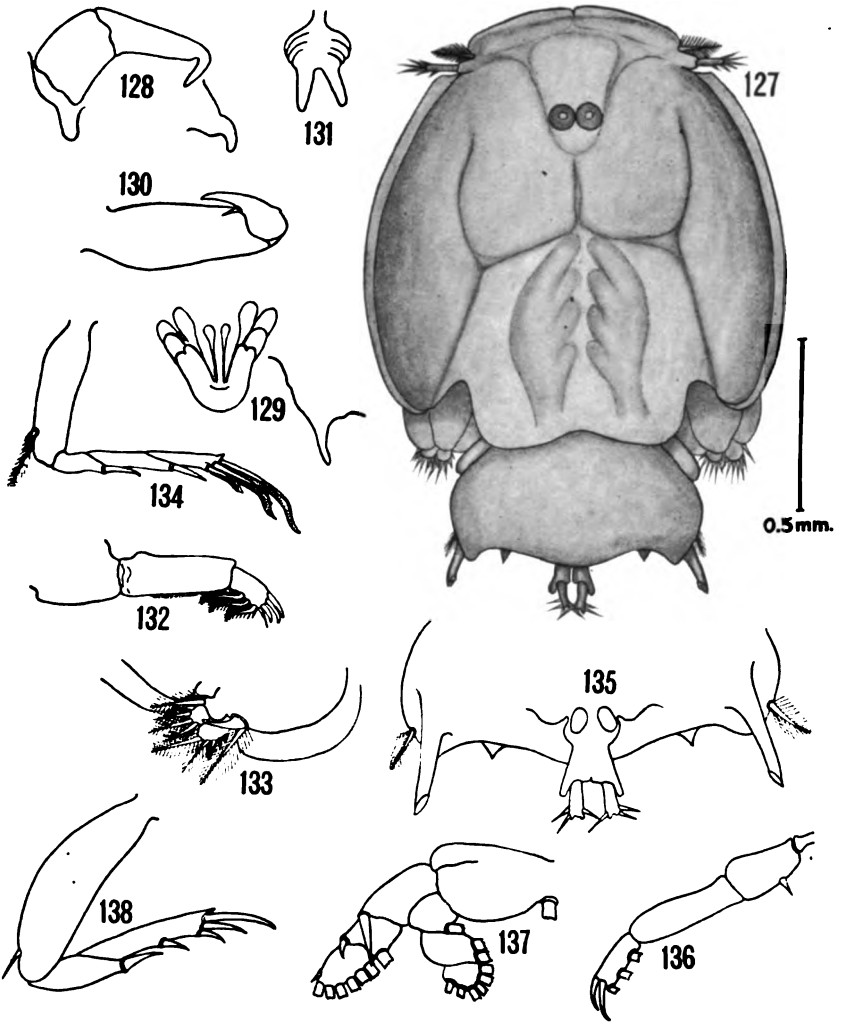


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 274.

Digitized by Google

Digitized by Google

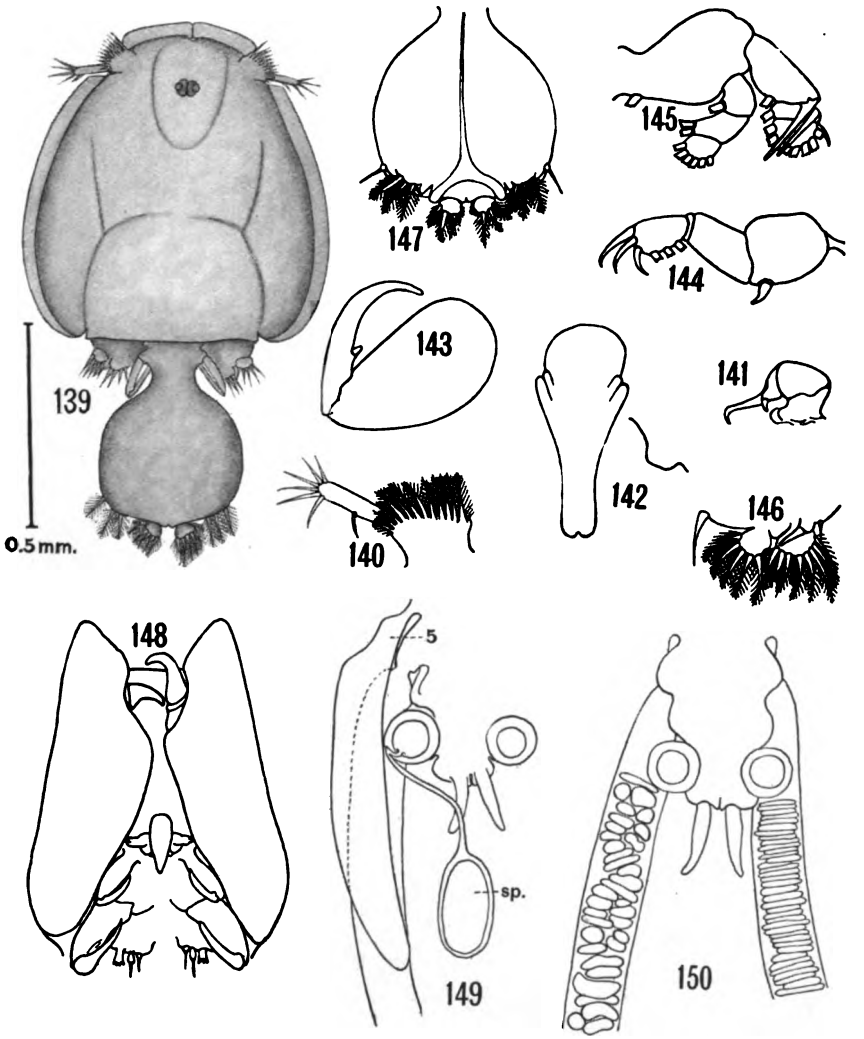


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 274.

Digitized by Google

Digitized by Google

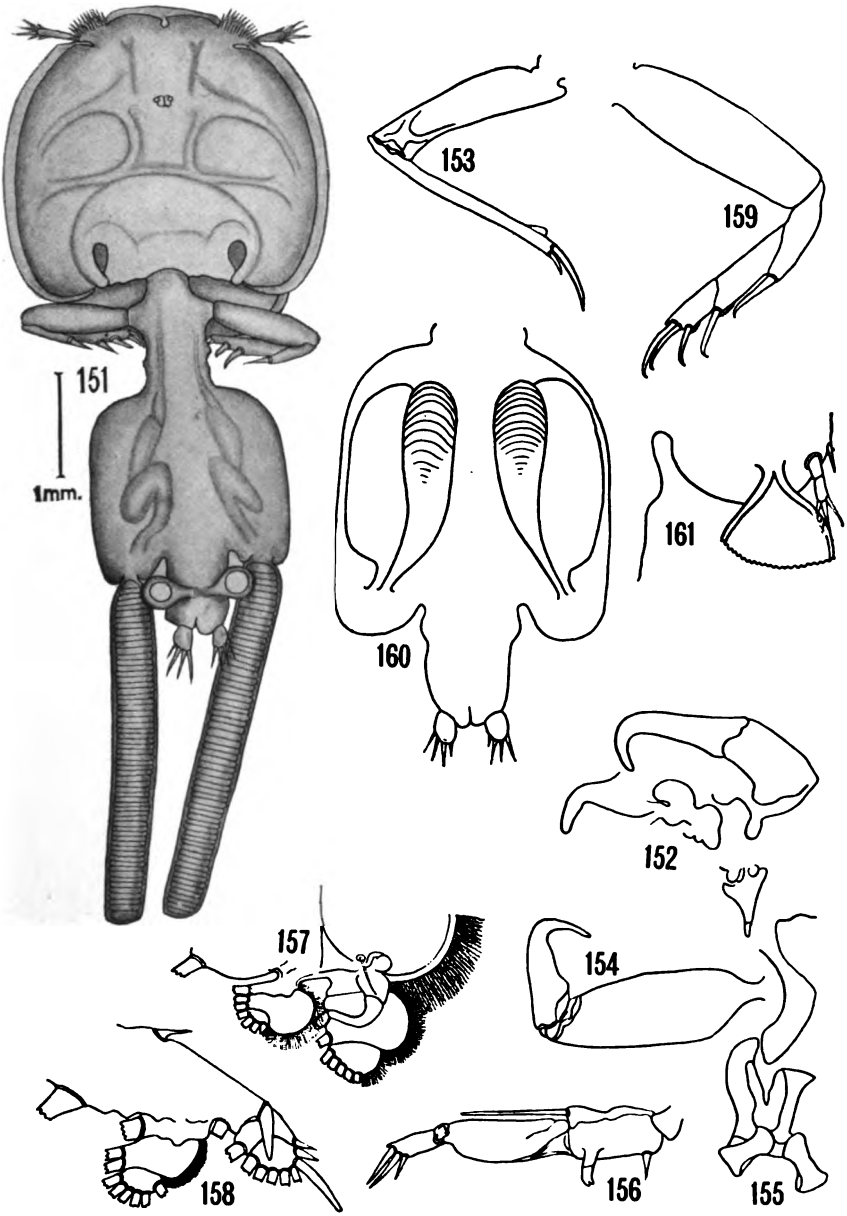


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 274.

Digitized by Google

Digitized by Google

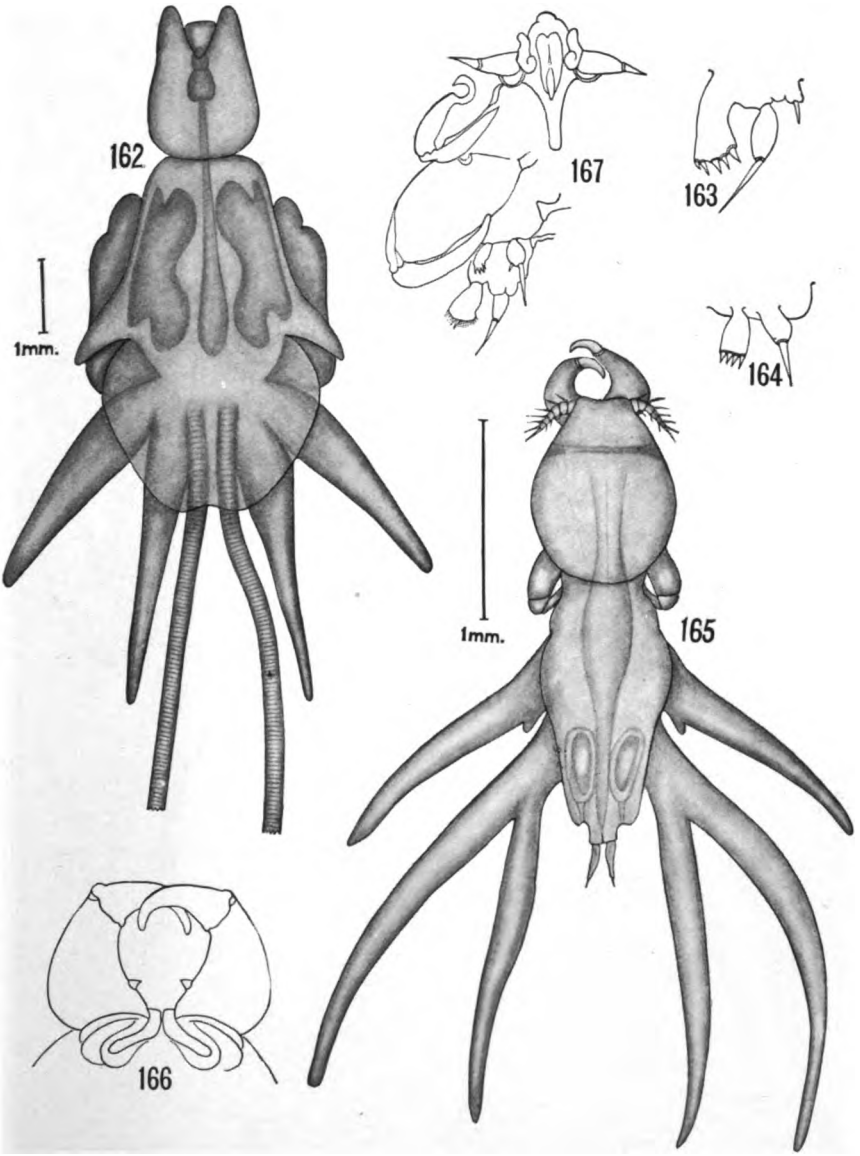


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 274.

Digitized by Google

Digitized by Google

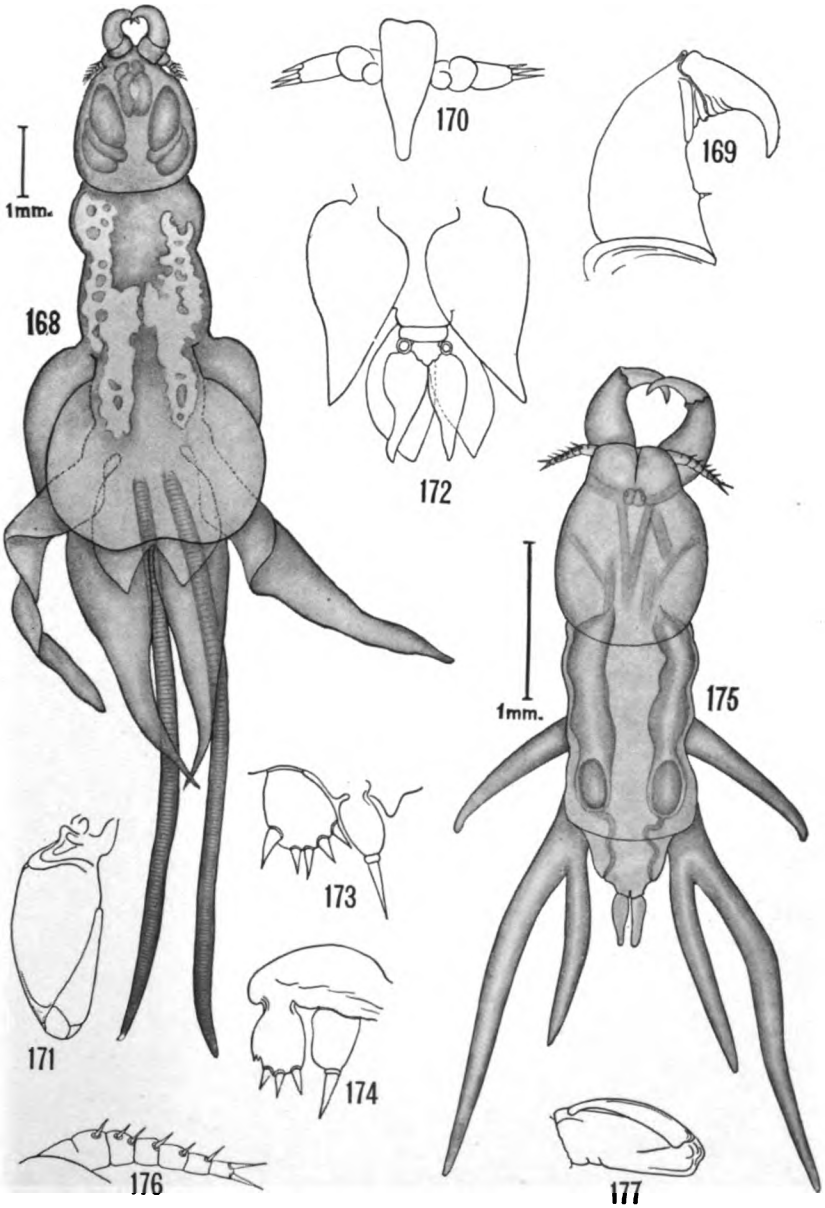


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 274.

Digitized by Google

Digitized by Google

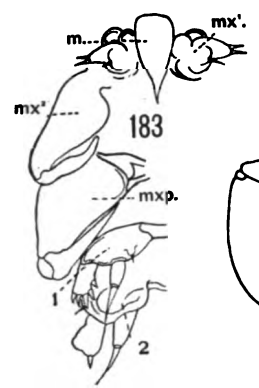


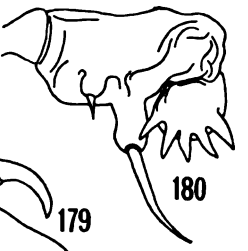
CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

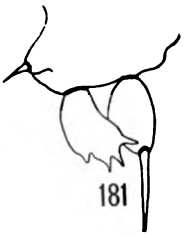
FOR EXPLANATION OF PLATE SEE PAGE 275.

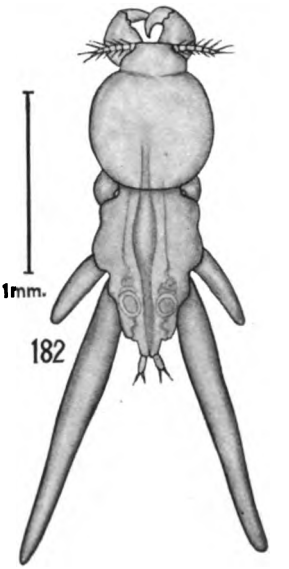
Digitized by Google

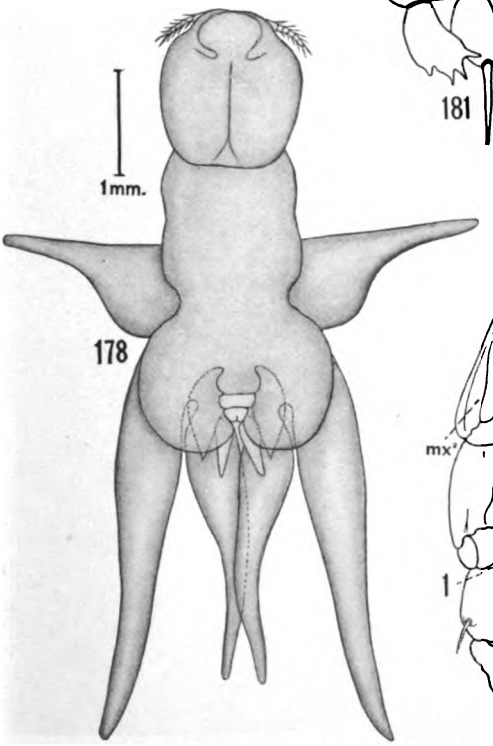
Digitized by Google

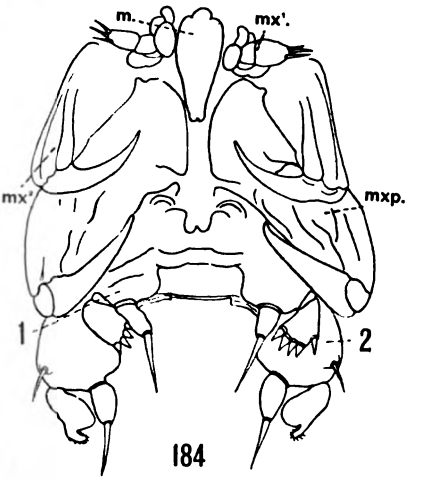










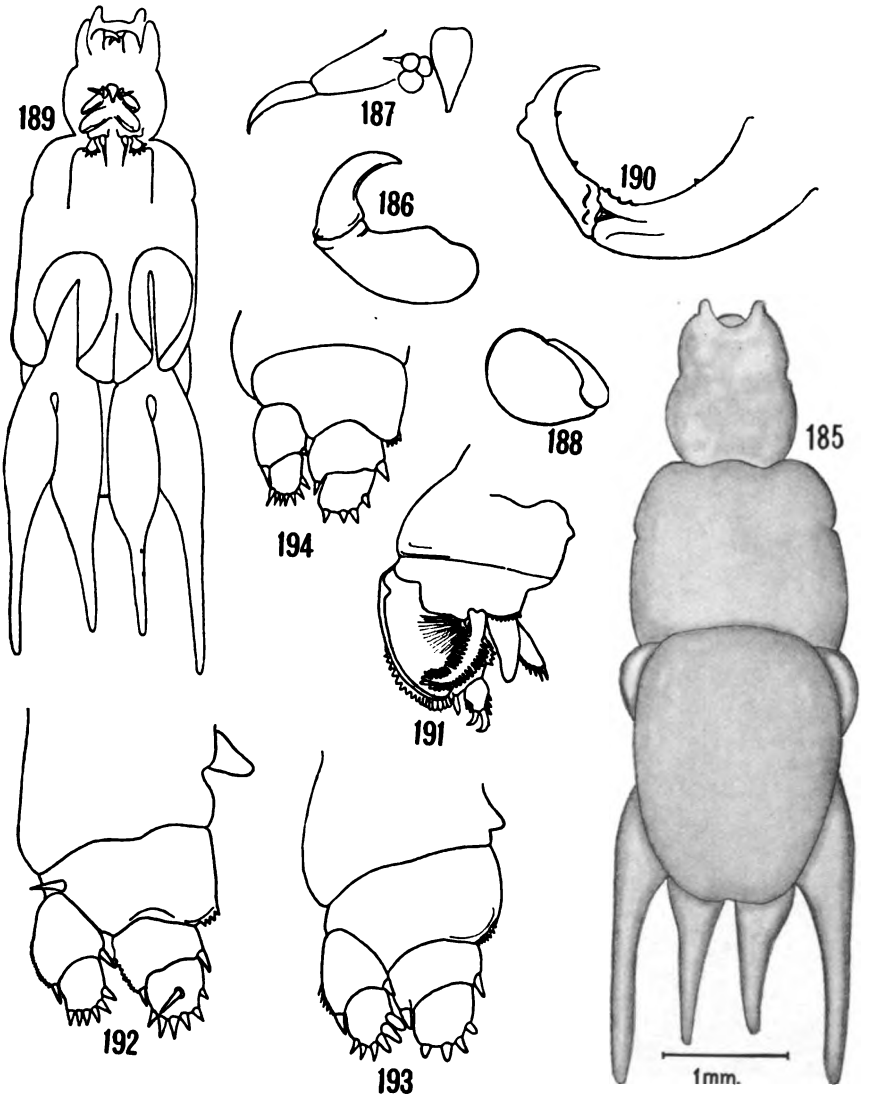


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 275.

Digitized by Google

Digitized by Google

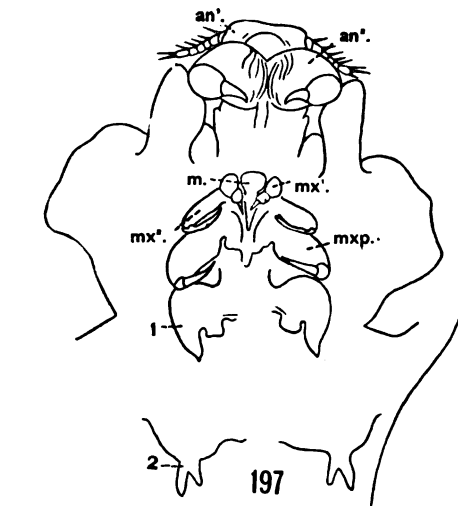


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

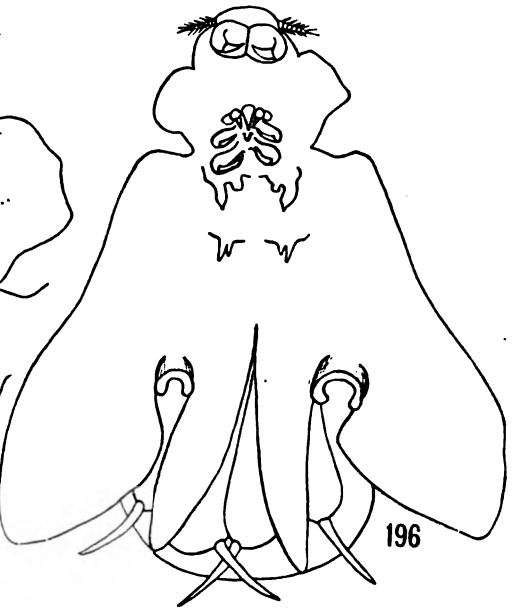
FOR EXPLANATION OF PLATE SEE PAGE 275.

Digitized by Google

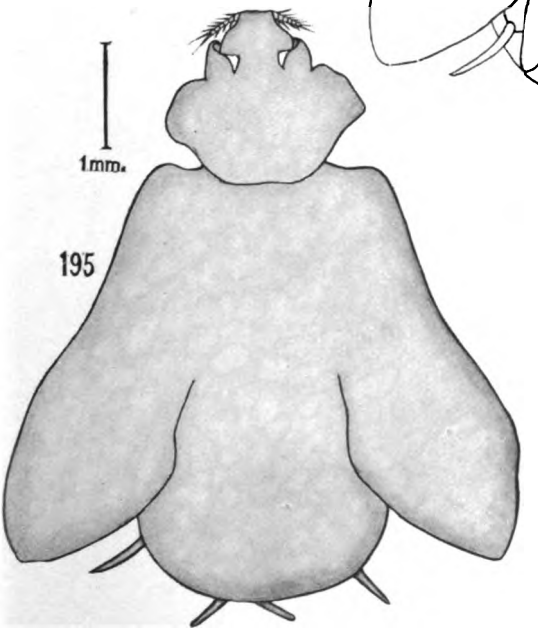
Digitized by Google



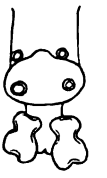
197



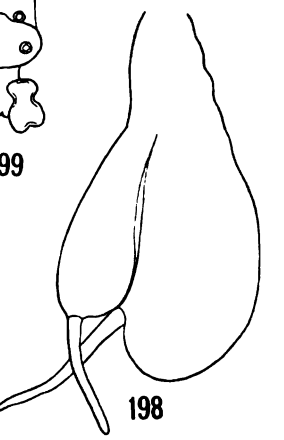
196



195



199



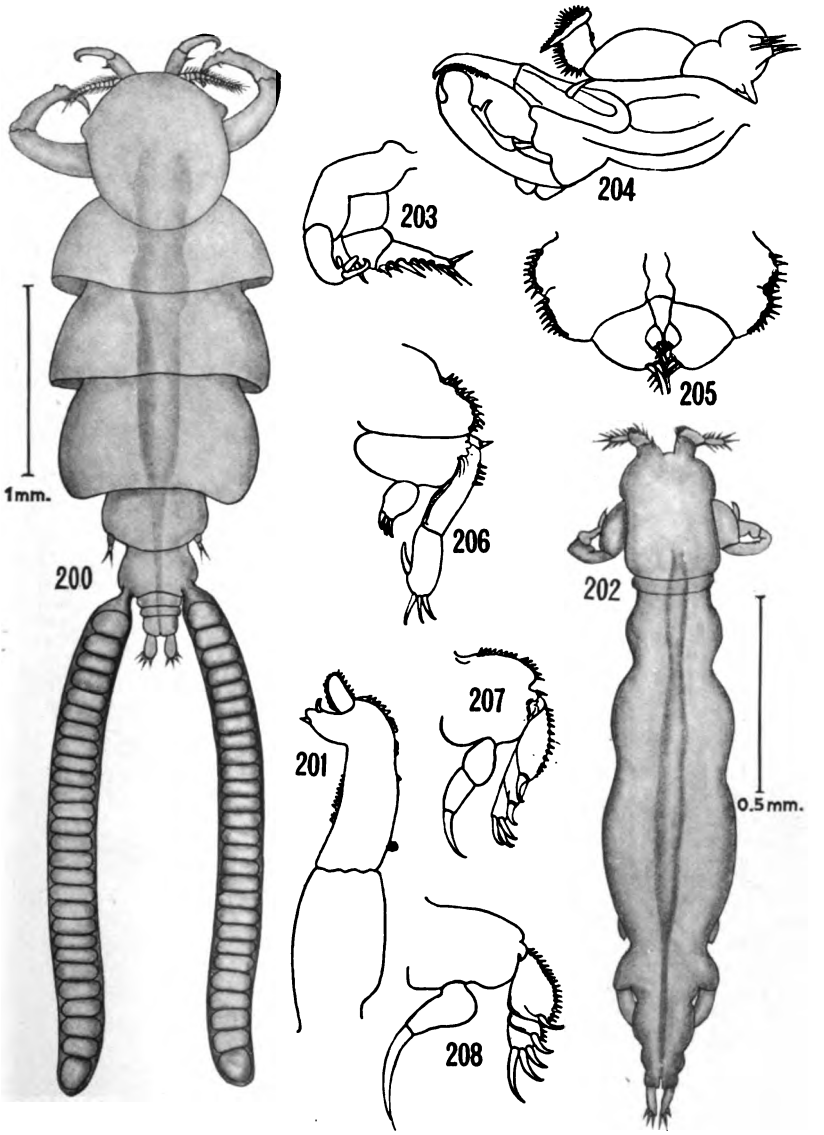
198

CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 275.

Digitized by Google

Digitized by Google

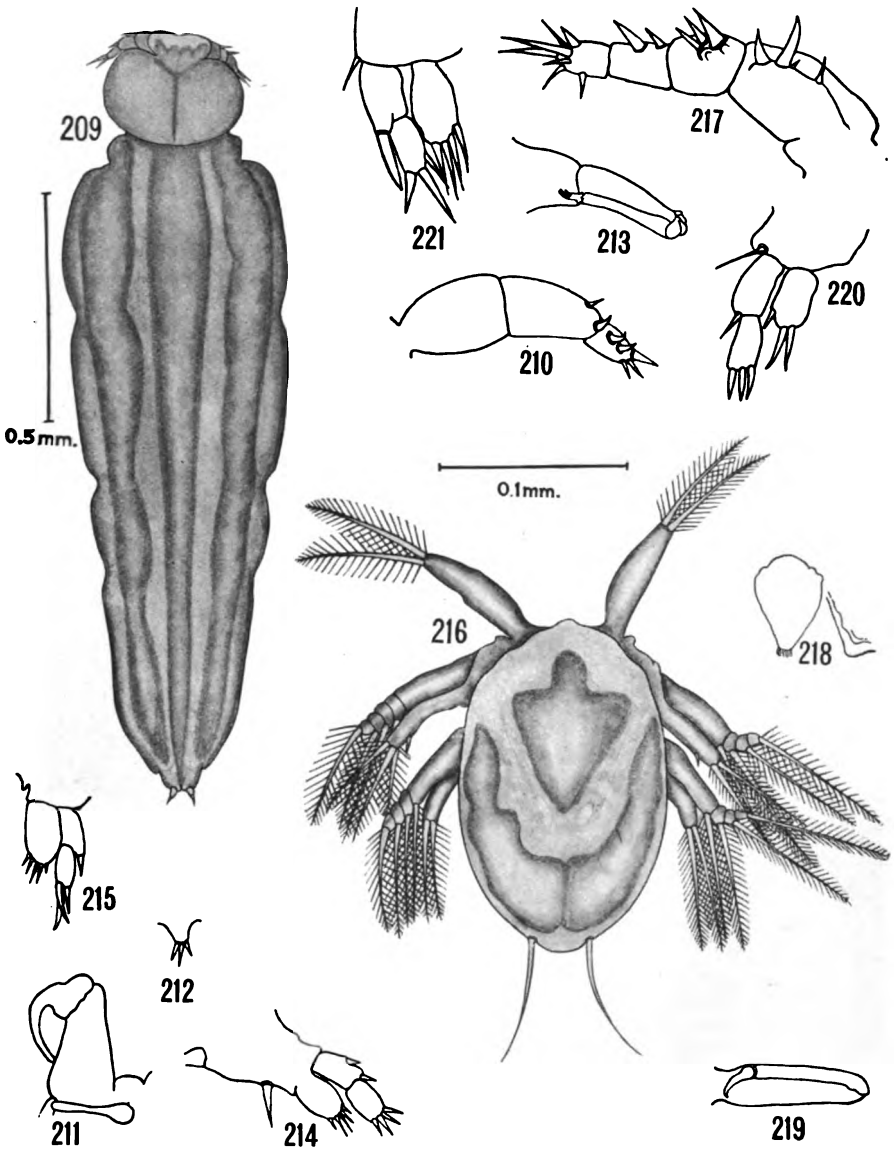


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 275.

Digitized by Google

Digitized by Google

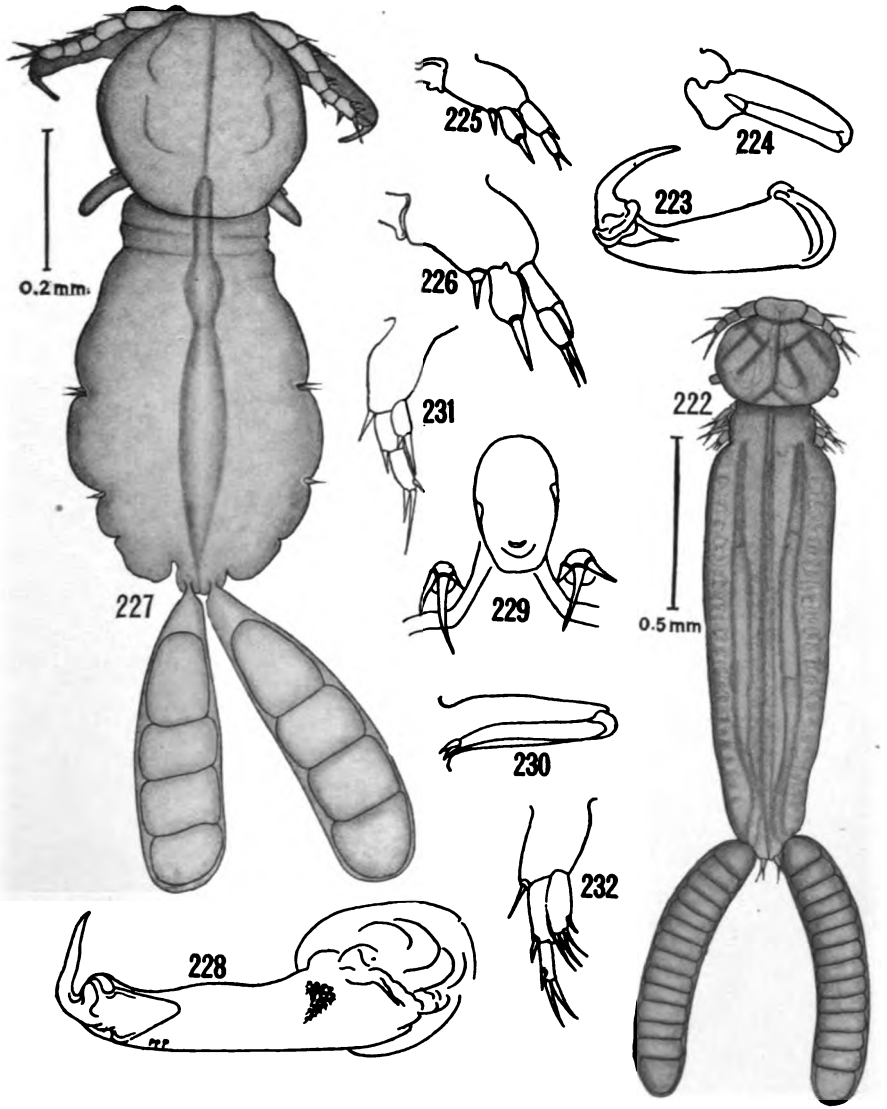


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 275.

Digitized by Google

Digitized by Google

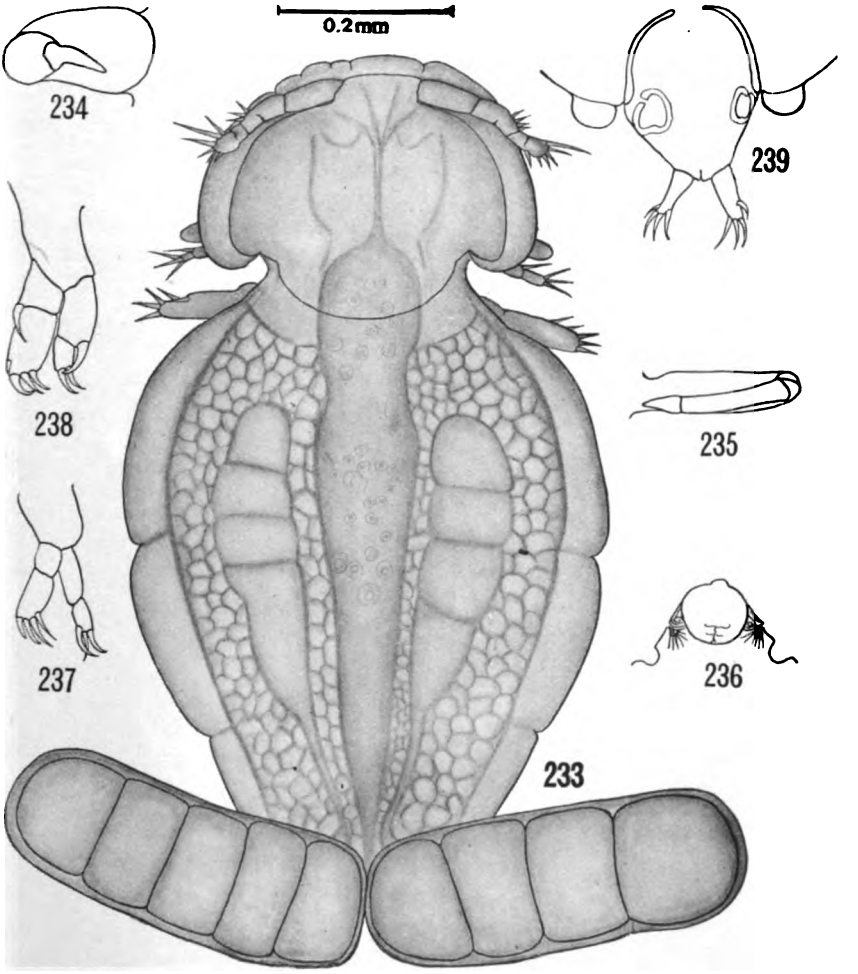


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 275.

Digitized by Google

Digitized by Google

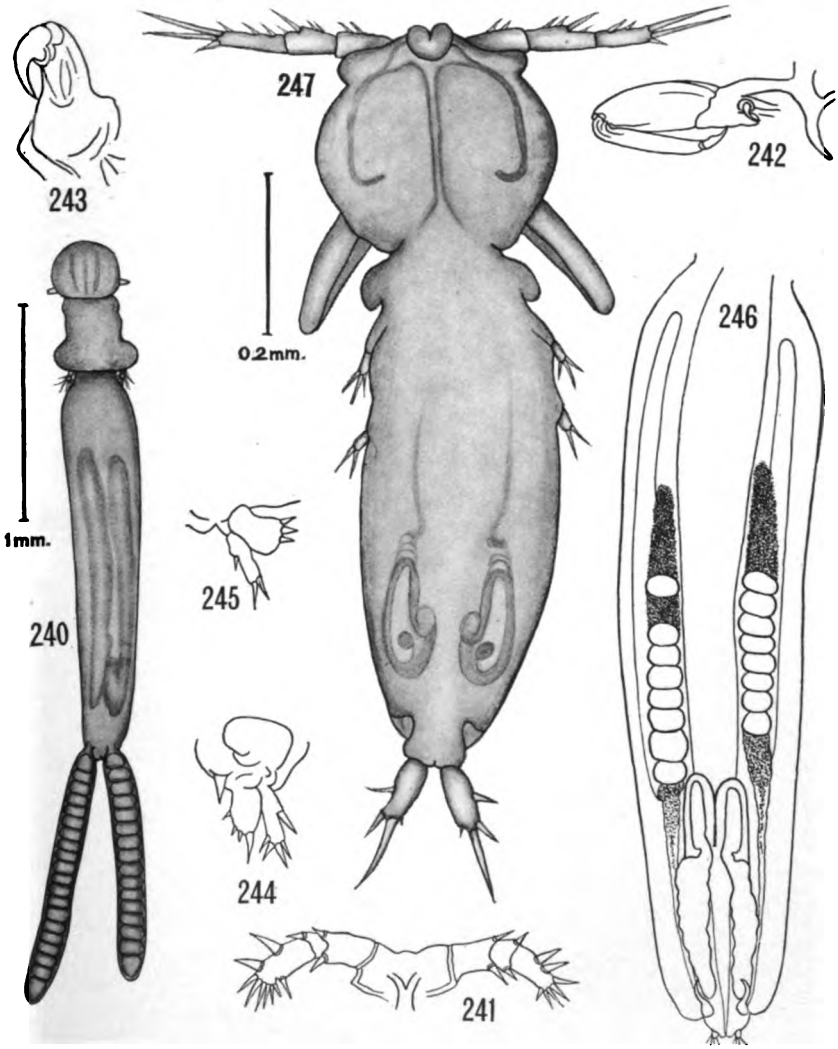


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 276.

Digitized by Google

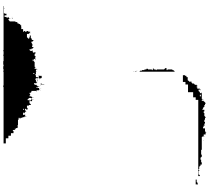
Digitized by Google



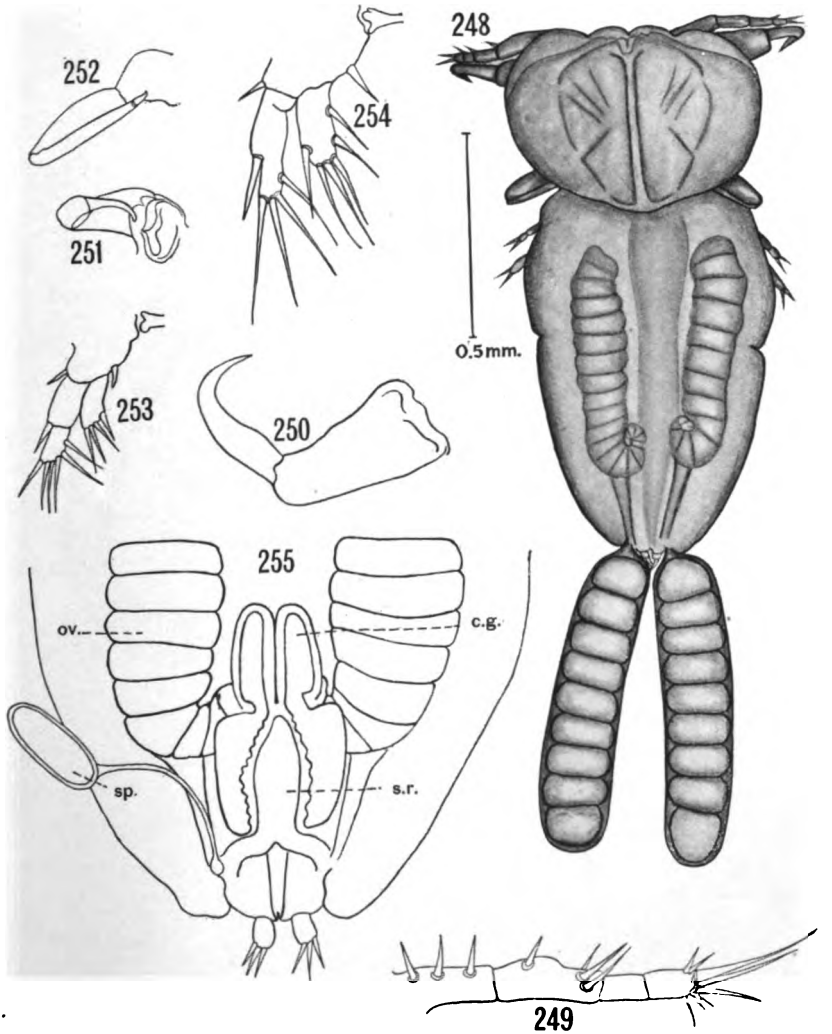
CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 276.

Digitized by Google



Digitized by Google

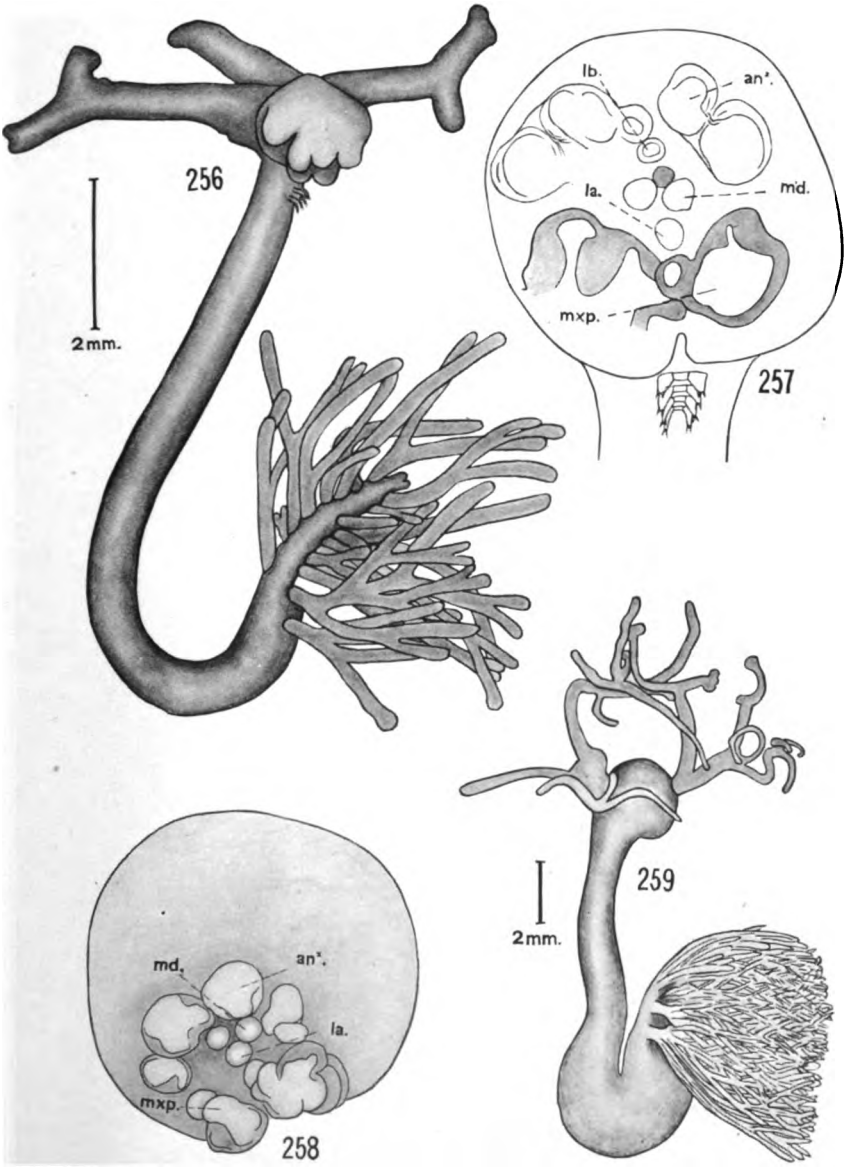


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 276.

Digitized by Google

Digitized by Google

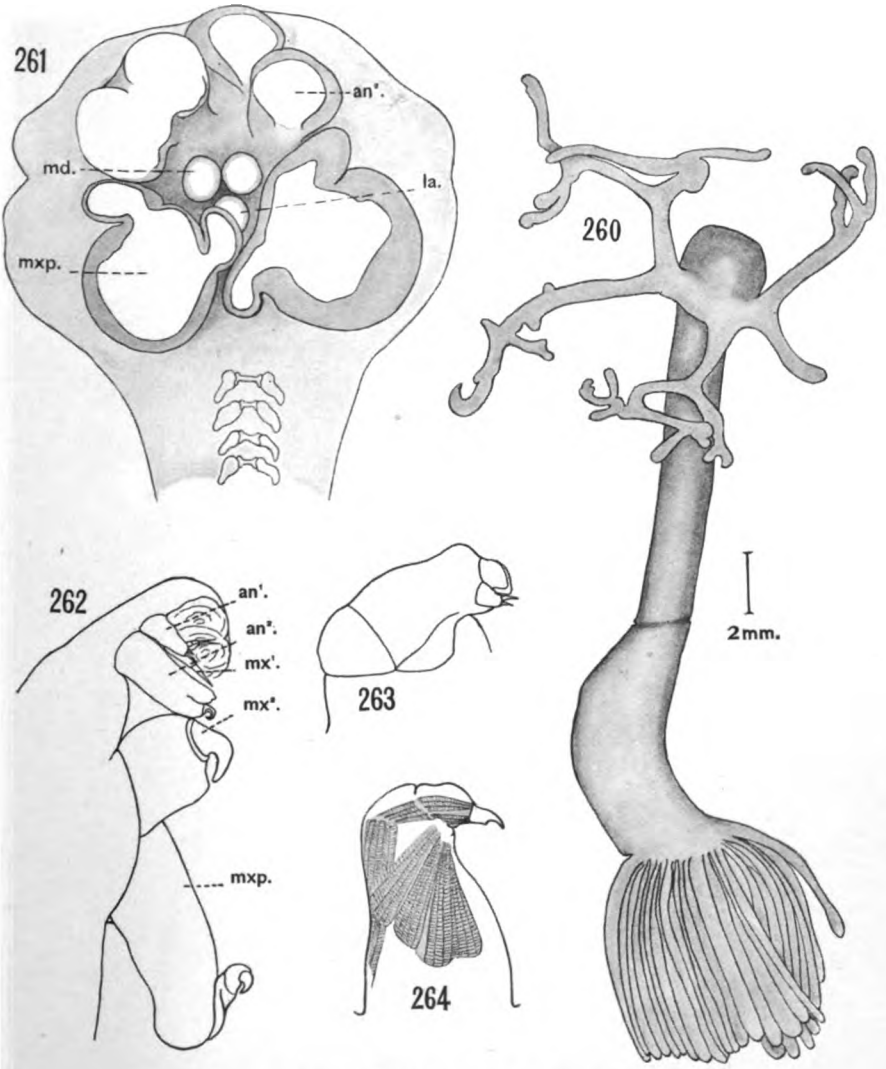


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 276.

Digitized by Google

Digitized by Google

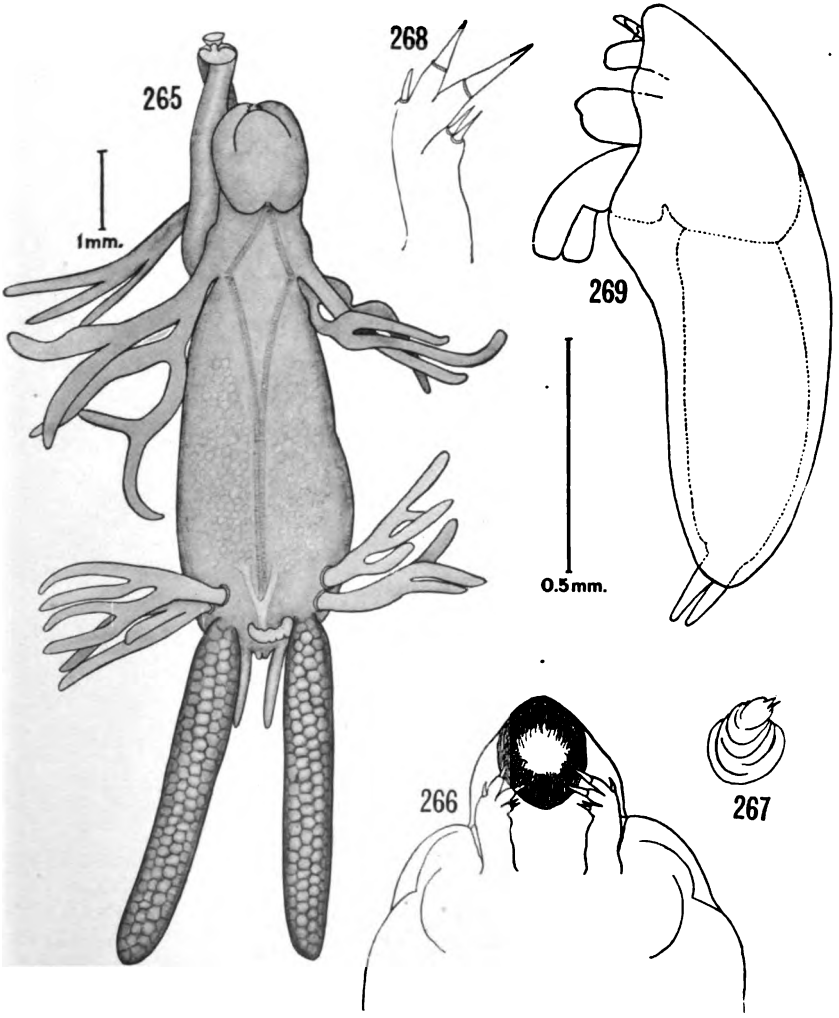


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 276.

Digitized by Google

Digitized by Google

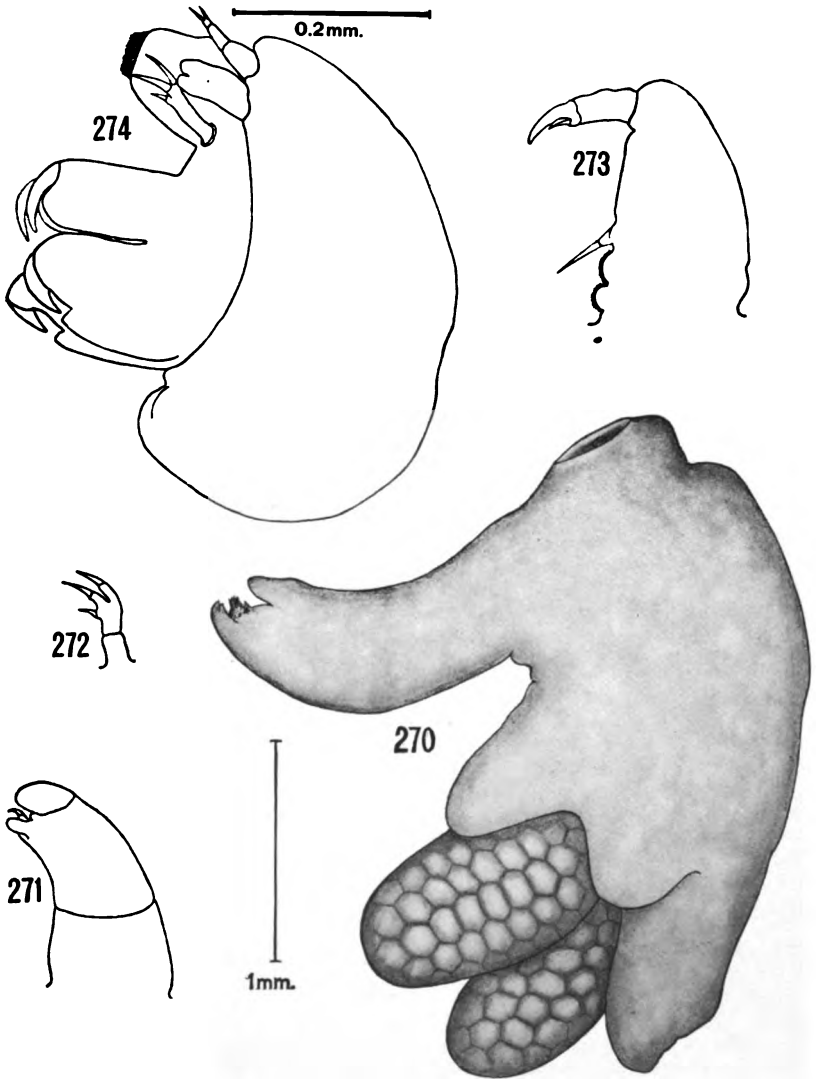


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 276.

Digitized by Google

Digitized by Google

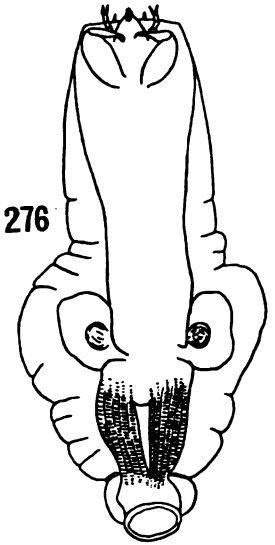


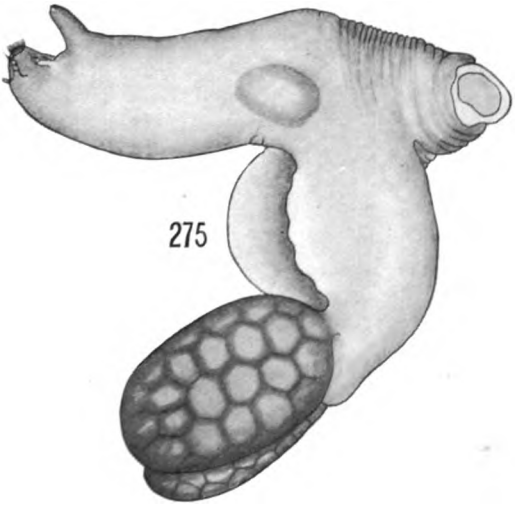
CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

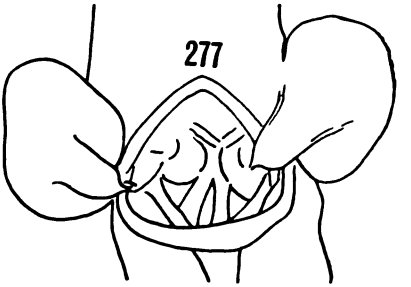
FOR EXPLANATION OF PLATE SEE PAGE 276.

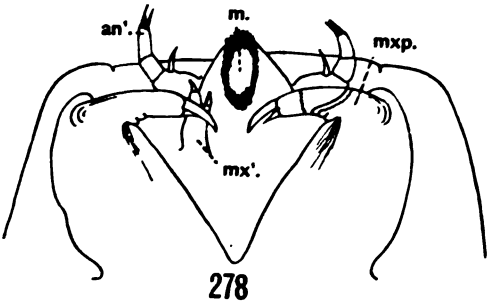
Digitized by Google

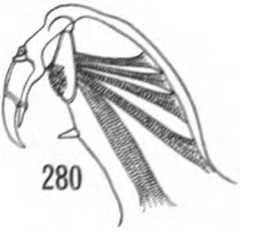
Digitized by Google









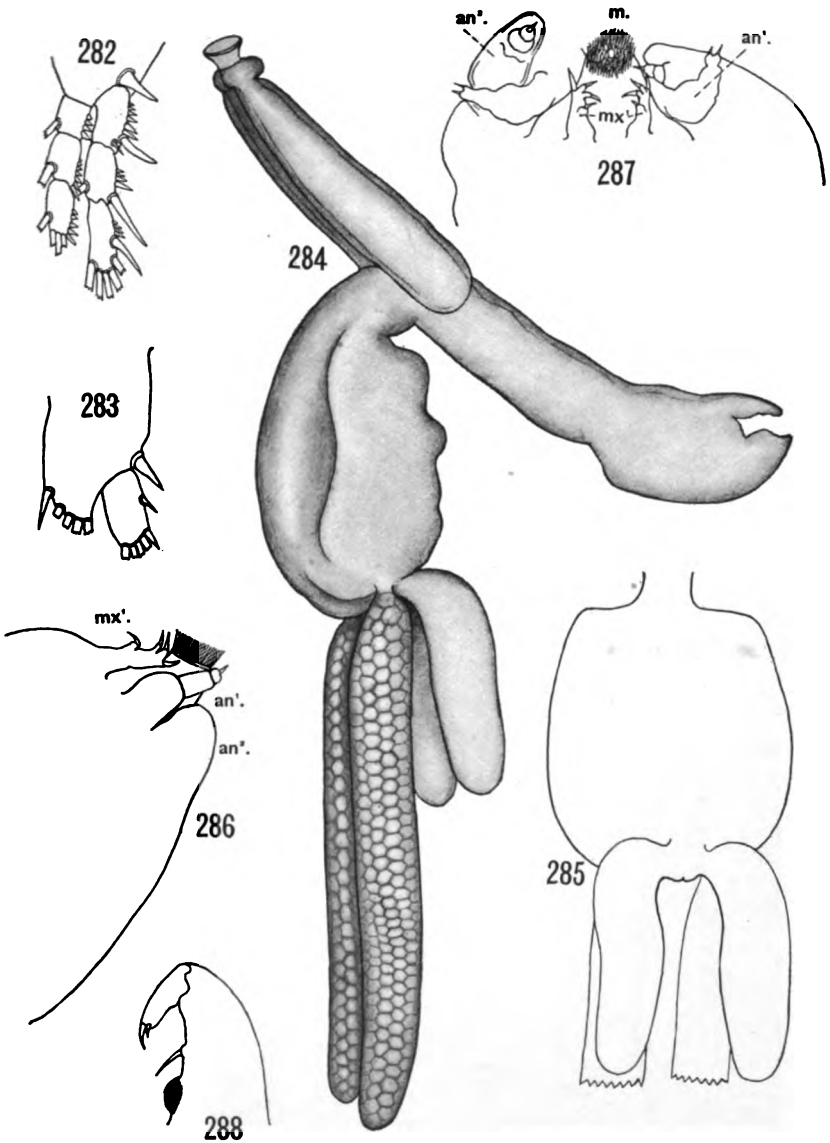


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 277.

Digitized by Google

Digitized by Google

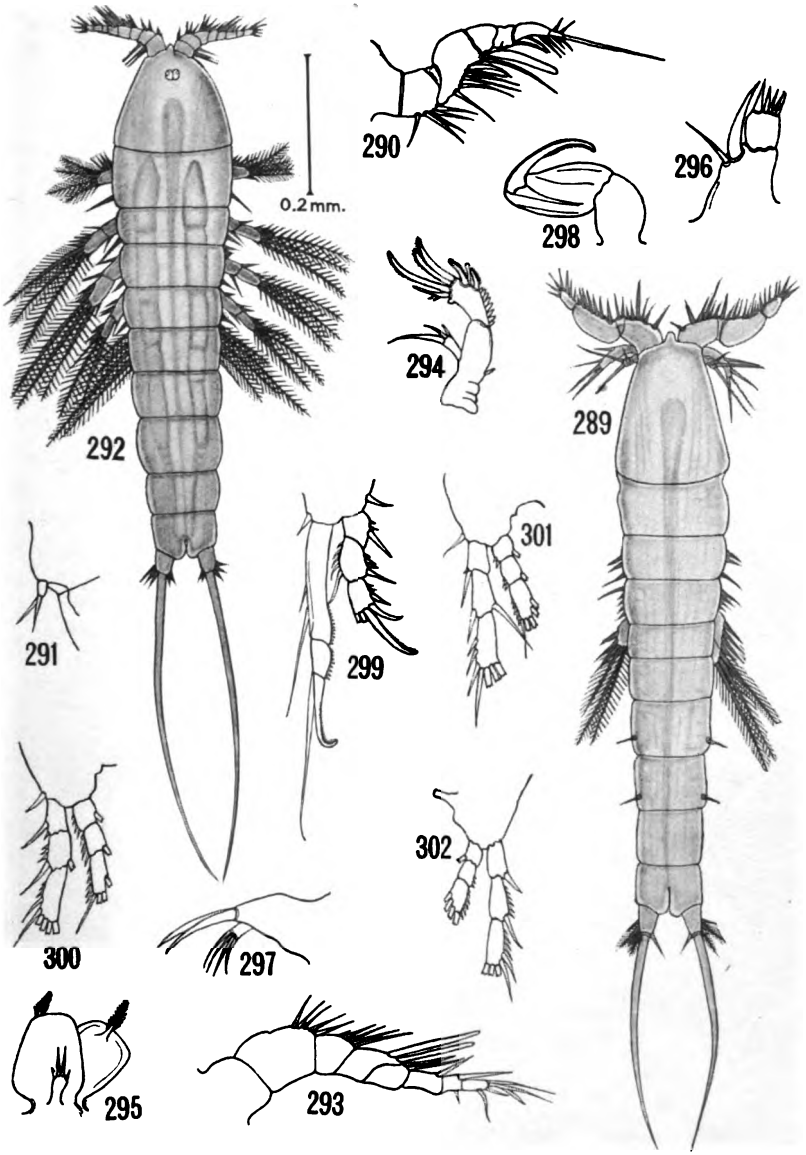


CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 277.

Digitized by Google

Digitized by Google

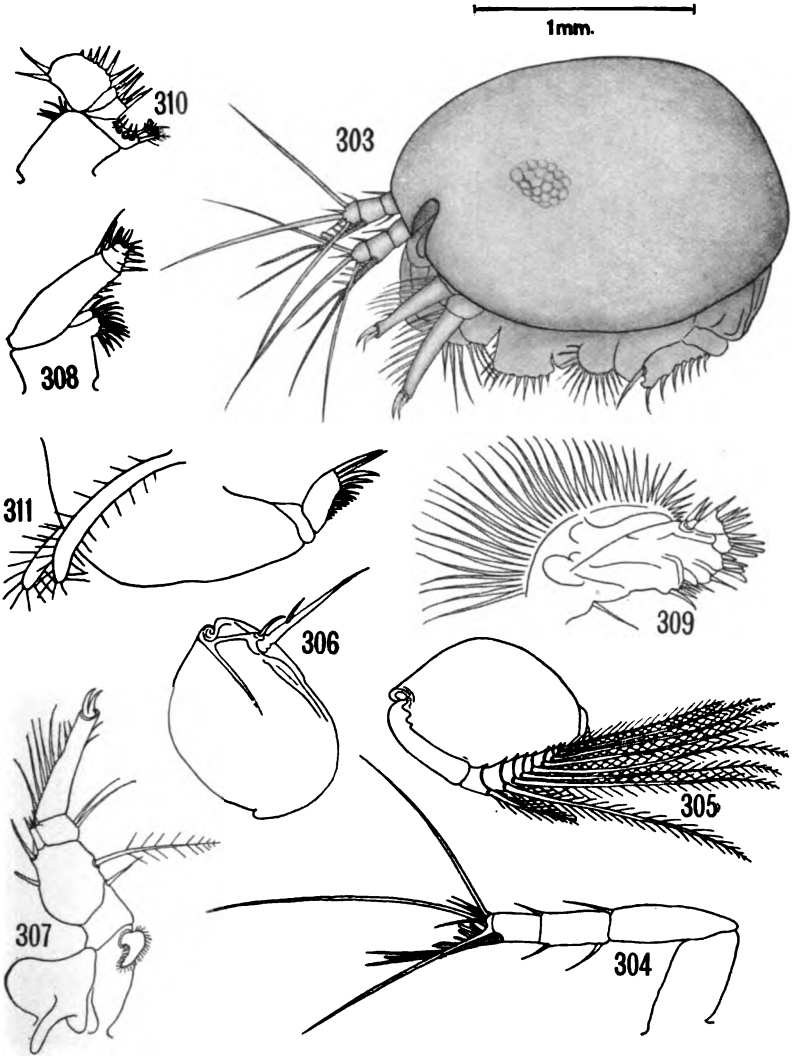


CRUSTACEAN PARASITES OF WEST INDIAN CRABS.

FOR EXPLANATION OF PLATE SEE PAGE 277.

Digitized by Google

Digitized by Google



CRUSTACEAN PARASITES OF WEST INDIAN FISHES.

FOR EXPLANATION OF PLATE SEE PAGE 277.

Digitized by Google

Digitized by Google

DESCRIPTIONS OF NEW LEPIDOPTERA, CHIEFLY FROM MEXICO.

By HARRISON G. DYAR,

Custodian of Lepidoptera, United States National Museum.

The following descriptions are in continuation of those already published on the Mexican fauna.[1] A few species are included from nearby regions, or which are especially allied to Mexican species here mentioned:

Family NYMPHALIDÆ.

Genus PHYCIODES Hübner.

PHYCIODES NATALCES, new species.

Fore wing with an emargination below the middle of the outer margin; black, the base variegated with rufous; spots buff; a small one in the cell, followed by a vertical rufous streak; a curved row of three beyond the cell, with an obscure one above near costa; a square spot between veins 2 and 3 with a little spot above and below, followed by a little rufous spot; two spots below vein 2, one near its origin, the other outwardly placed; another similarly placed spot above vein 4; a faint submarginal row of crescents, of which only the two central ones are distinct. Hind wing with the base variegated with rufous streaks, two curved ones on the cell being prominent; an outer mesial buff band, narrowly cut by the veins, not reaching costa or margin; beyond it a narrow rufous line, cut by the veins; a submarginal row of narrow crescents; fringe crenulate, whitish tipped. Beneath the basal third of fore wing is whitish, variegated with brown lines, with an irregular curved black line shortly before the termination of the pale arc; outer two-thirds of the ground black; a broad pale bar in end of cell with digitate outer margin; spots repeated, enlarged, white, scarcely cut by the veins; a narrow pale line joining the large median spot to costa; termen shaded with whitish and rufous, cut by black shades subapically and

[1] Proc. U. S. Nat. Mus., vol. 38, 1910, pp. 229-273; Proc. U. S. Nat. Mus., vol. 42, 1912, pp. 39-106.

Digitized by Google

at tornus. Hind wing with the ground whitish, tinged with rufous; base variegated with brown and rufous lines; a narrow mesial black line across the wing in irregular course, separating the basal variegated area from the outer one; a submarginal row of broad crescents, edged within by black and followed by the brown termen, obscured by a black cloud between veins 5 and 6; an outer mesial row of black spots, faintly surrounded by rufous; a black cloud on costa in the mesial area. Expanse, 39 mm.

Type.—Female, No. 14487, U.S.N.M., Rascon, San Luis Potosi, Mexico, August, 1911 (R. Müller).

Family HESPERIIDÆ.

Genus THESPIEUS Godman and Salvin.

THESPIEUS DALMANI GUERRERONIS, new subspecies.

Differs from *Thespieus dalmani* Latreille principally in the size of the brown spot on the hind wings below, which is large, triangular, its lower angle reaching as far as the end of the inner white spot.

Cotypes.—Three males, No. 14488, U.S.N.M., Baleas, Gurrero, 1,500 feet, August, 1906; Iguala, Guerrero, 2,400 feet, June, 1906; Naranjo, Guerrero, Mexico, 3,000 feet, August, 1906 (W. Schaus).

THESPIEUS CACAJO, new species.

Bronzy black above, yellowish shaded at the bases of the wings; spots yellowish hyaline; discal spot square, constricted centrally; three small wedge-shaped spots below the costa at outer fourth; three oblique spots below, the upper two quadrate, middle one large, lower one wedge-shaped; male with a long narrow brand, cut into two segments by vein 2. Hind wing with three spots on the disk, divided only by the veins, narrowing toward apex and without any following yellow shades. Beneath the spots are repeated; fore wing with a broad ferruginous yellow stain beyond the subapical spots, followed by a purplish line; hind wing with mottled purplish shading across the disk within the middle; a large brown triangular spot below the hyaline spots, edged narrowly with purplish; three ferruginous-red spots beyond the hyaline spots, separated by the veins. Expanse, 36–40 mm.

Cotypes.—Two males, one female, No. 14489, U.S.N.M., Naranjo, Guerrero, Mexico, 3,000 feet, August, 1906 (W. Schaus); Cuernavaca, Mexico, August, 1906 (W. Schaus).

THESPIEUS ZAOVINIA, new species.

Black, the wings a little bronzy, especially toward base; spots whitish hyaline; discal spot large, strongly constricted; three small subapical elongate quadrate spots, the middle one moved inward

Digitized by Google

out of line; three lower outer spots, the upper two quadrate, middle one large, lower one minute. Hind wing with five small spots across the disk in an irregular row, the upper two separated only by a vein. Beneath the markings are repeated; the hind wings are washed with dense gray irrorations; there is a whitish costal spot beyond the middle, not shown above, two spots within it across the disk and another subbasal below vein 8. Expanse, 35 mm.

Type.—One male, No. 14490, U.S.N.M., Tehuacan, Mexico, August, 1911 (R. Müller).

This species is close to *T. ovinia* Hewitson, but the subapical spots of the fore wing are not in line and the spots on the hind wing below are narrow.

Genus AMBLYSCIRTES Scudder.

AMBLYSCIRTES TUTOLIA, new species.

Black, slightly bronzy, the fringes pale outwardly; the fore wing has a small elliptical yellowish spot in the outer lower part of the cell; three small costo-subapical spots and a small spot below above vein 3; male with a narrow oblique black brand. Beneath the spots are repeated, increased in number, the fore wing having a row of seven beyond the cell-spot, the fourth and fifth projected outward, the seventh an oblique dash; brand repeated, surrounded by black; a broad light yellow shade above vein 1, beginning at the middle of the wing and spreading outwardly. Hind wing below brownish black, with eight spots in a broad circle and a central one in the cell, all small, whitish, elliptical. Expanse, 32 mm.

Type—One male, No. 14491, U.S.N.M., Sierra de Guerrero, Mexico, August, 1911 (R. Müller).

Genus STAPHYLUS Godman and Salvin.

STAPHYLUS HOLAPHEGGES, new species.

Black above, slightly bronzy, without markings; brown-black below. Palpi grayish beneath, having white scales intermixed; abdomen with the venter gray with central black line. Expanse, 22 mm.

Cotypes.—Five specimens, No. 14492, U.S.N.M., Misantla, Mexico, July, 1911 (R. Müller).

Genus ARGOPTERON Watson.

ARGOPTERON DIVIDUUM, new species.

Black; fore wings with yellow-hyaline spots; a square one in the end of the cell separated by the median vein from a larger one below, of which the lower portion is cut by vein 2; three small costo-subapical spots, fused, separated only by the veins; a small spot below above vein 3. Hind wing with a large spot beyond the cell,

Digitized by Google

its lower tip cut by a vein; a wedge-shaped spot below, succeeded by a smaller one; fringe irregularly marked with yellow. Beneath the fore wing is grayish black, the spots repeated, the apical margin washed with bronzy reddish, cut by dark veins. Hind wing all washed with bronzy reddish, the spots repeated, yellow and in addition a long one in base of cell and subcostal one above it; a row of blackish spots subcostally outwardly, continued in a faint double submarginal row around the wing; subterminal area a little lighter and cut by darker veins. Expanse, 26–30 mm.

Cotypes.—Six specimens, No. 14493, U.S.N.M., Sierra de Guerrero, Mexico, August, 1911 (R. Müller); Iguala, Guerrero, Mexico, 2,400 feet, June, 1906 (W. Schaus); Naranjo, Guerrero, Mexico, 3,000 feet, August, 1906 (W. Schaus).

Genus MEGATHYMUS Scudder.

MEGATHYMUS RETHON, new species.

Black, with a slight blue luster; fore wing with one small, faint, whitish subcosto-subapical spot—no other markings; fringe checkered black and white. Hind wing with the fringe white, narrowly cut by black at the ends of the veins, the white color spreading up on the margin of the wing, especially centrally. Fore wing beneath as above, except that there are three closely crowded costo-subapical whitish spots. The hind wings have a slight grayish cast, especially submarginally in faint spots and terminally, the fringe white, cut by black as on the upper side, but there is a narrow terminal black line distinctly separating the fringe, which is not present above. Expanse, 50 mm.

Type.—No. 14494, U.S.N.M., Sierra de Guerrero, Mexico, August, 1911 (R. Müller).

Family SATURNIIDÆ.

Genus HYLESIA Hübner.

HYLESIA SUBAUREA Schaus.

Hylesia subaurea Schaus, Journ. N. Y. Ent. Soc., vol. 8, 1900, p. 227, female.
Hylesia coadjutor Dyar, Journ. N. Y. Ent. Soc., vol. 15, 1907, p. 51, male.

H. coadjutor is probably the male of *H. subaurea*. The sexes in this genus are often very dissimilar, but there is a certain general resemblance between these two types which suggests that they may be conspecific. Both come from the same locality.

HYLESIA IOLA, new species.

Male.—Carneous brown; thorax darker and more ocherous, the front, orbits, and legs shaded with crimson; abdomen black above, with long ocherous hairs. Fore wing with two rigid lines, a little curved, brown with inner whitish edging, shortly and sharply bent

Digitized by Google

at costa; a faint dark discal cloud; traces of a pale waved submarginal line. Hind wing crimson tinted on the disk, with a discal dull crimson thick annulus; traces of a dull crimson submarginal band. Expanse, 45 mm.

Female.—Thorax above and below and both wings dull crimson; abdomen black above, ocher brown beneath. Fore wing with traces of the outer band, of which the pale inner edging is most distinct; traces of the pale waved submarginal line. Hind wing with discal small dull crimson annulus faintly shown, much smaller than in the male. Expanse, 54 mm.

Cotypes.—Male and female, No. 14689, U.S.N.M., Mexico City, Mexico, December, 1909 (R. Müller).

HYLESIA COINOPUS, new species.

Purplish brown; body parts ocher brown; feet concolorous, without any crimson tint. Both wings with rounded dark discal marks, diffused but distinct; an outer pale band, wavy in the male, straighter in the female, faint on the hind wing in the male and absent in the female; traces of a wavy submarginal whitish line. Expanse, 35–48 mm.

Cotypes.—Male and female, No. 14690, U.S.N.M., Coatepec, Mexico, August, 1911 (W. Gugelmann).

Larva.—Head rounded, higher than wide, smooth, shining, mahogany brown, the sutures paler; secondary hairs white, rather numerous below, but fine and not conspicuous. Body cylindrical, smaller in front, yellowish, thickly dotted with black, leaving wavy addorsal and subdorsal, and straight lateral and subventral lines of the ground color and forming broken narrow transverse black lines deep in the segmental incisures. Venter and bases of feet pale; feet reddish, thoracic feet pale brown. Spines with the shafts weak and soft, pale, subdorsal row with single median spine on joints 12 and 13, those on joint 2 long but like the others in color and structure; lateral row about like the subdorsal; subventral row shorter.

The adult resembles *H. continua* Walker, as determined by W. Schaus, but is larger, more rosy, and the whitish transverse lines are much more distinct.

Family CITHERONIIDÆ.

Genus SISPHYNX Hübner.

SISPHYNX MODENA, new species.

Center of thorax and more or less of dorsum of abdomen dark ocher; patagia pale purplish; body below creamy white. Fore wing yellow with orange tint, very slightly freckled with brown; inner line curved, outer oblique and straight from apex to middle of inner margin, both pale brown; one or two small white discal dots, surrounded

Digitized by Google

by a brownish cloud; in the male the basal and terminal spaces are filled in with pale purplish. Hind wing pale yellow with a dark crimson patch on basal half of inner margin, in the male forming also a small spot at end of cell. Expanse, male 54 mm.; female 70 mm.

Cotypes.—Three males, one female, No. 15218, U.S.N.M., Cuernavaca, Mexico, June, 1906 (W. Schaus), June, 1912 (R. Müller).

Family SYNTOMIDÆ.

Genus EUROTA Walker.

EUROTA DESCINTES, new species.

Black; collar with white point at side; fore coxæ marked with white; fore femora fringed with crimson; abdomen with lateral row of elliptical white spots, and a small sublateral row, the ventral valve of the male narrowly edged with white, anal tuft crimson; antennæ with white at the tip; fore wing with the costa swollen at base, containing an elongate whitish hyaline spot; a white point at base; a quadrate spot below the costal mark, two near the middle of the wing and a row of four pyriform ones before apex. Hind wing with a spot near base and a large quadrate one outwardly, with a small spot below it. Expanse, 46–51 mm.

Cotypes.—Five males, five females, No. 14691, U.S.N.M., Morelos, Mexico, 7,000 feet, 1906 (W. Schaus).

Near *E. vulcanus* Walker, but the fore legs only with a red fringe, the white markings smaller throughout and the swelling at base of costa larger.

Family LITHOSIIDÆ.

Genus PTYCHOGLENE Felder.

PTYCHOGLENE STENODORA, new species.

Black, with slight blue reflection; fore wing with a vermillion subcostal stripe, widening outwardly from base and terminating a little obliquely halfway between cell and margin. Hind wing with a costal stripe terminating before apex. Beneath the whole of the fore wing is red except a narrow costal stripe and broad outer margin; hind wing with the red area only a little wider than above. Expanse, 36 mm.

Cotypes.—Two females, No. 14300, U.S.N.M., Tehuacan, Mexico, June, 1910 (R. Müller).

Family ARCTIIDÆ.

Genus EUCHAETIAS Lyman.

EUCHAETIAS CRESSIDA, new species.

Head pale gray in front, orange on the vertex. Abdomen orange above, white with a gray tint below, with dorsal and lateral rows of

Digitized by Google

black spots. Thorax white with a gray tint. Wings white, shining, the fore wing gray beneath. Expanse, 33 mm.

Type.—One male, No. 14461, U.S.N.M., Cerritos, San Luis Potosi, August, 1911 (R. Müller).

EUCHAETIAS RHADIA, new species.

Dark gray; abdomen crimson above with small dorsal black spots and lateral dashes, whitish below in the male, gray in the female. Fore wing gray, with a very slight brown tint and hardly any white dusting. Hind wing darker, purer gray in the male, dark, almost blackish in the female. Expanse, 32–42 mm.

Cotypes.—Two males, one female, No. 14462, U.S.N.M., Mexico? (J. Doll); Jalapa, Mexico (Schaus collection).

This appears to be Hampson's subspecies 1 of *E. expressa* H. Edwards, but I am inclined to regard the form as specifically distinct.

EUCHAETIAS EPAGOGA, new species.

Light gray, the neck pink, the fore coxæ touched with pink. Abdomen crimson above with dorsal and lateral black spots, white below in the male, gray in the female, Fore wing very light gray, almost white in ground, but thickly dusted with gray scales, leaving an indistinct outer pale band. Hind wing pale gray in the male, though a little darker than the fore wing, still darker in the female and showing considerably darker than the fore wing in that sex. Expanse, 35–42 mm.

Cotypes.—Two males, one female, No. 14463, U.S.N.M., Tehuacan, Mexico, August, 1911, September, 1910 (R. Müller); Oaxaca, Mexico (Schaus collection).

This is not quite so light in color as *E. mitis* Schaus (which is Hampson's subspecies 2 of *E. expressa* H. Edwards), which has the hind wings nearly pure white in the male, but the fore wings are less densely powdered than in *mitis* and consequently appear lighter. *E. mitis* occurs in Costa Rica.

Genus CALIDOTA Dyar.

CALIDOTA CALOSOMA, new species.

Thorax light yellow, the patagia streaked with ocher, disk crimson; vertex of head ocher, front fuscous. Abdomen crimson at the base, then slaty gray, the anal tuft ocher; pleuræ and pectus crimson; legs slate gray; antennæ nearly black. Wings rather thinly scaled and semitranslucent; fore wing uniform gray; hind wing a little paler and decidedly translucent over the discal area. Expanse, 46 mm.

Type.—One male, No. 14460, U.S.N.M., Orizaba, Mexico, September, 1911 (R. Müller).

Digitized by Google

Genus AMMALO Walker.

AMMALO TENEROSA, new species.

White, the head, fore coxæ, collar and base of costa of fore wings ocherous; fore tibiæ gray; abdomen ocher above except at base with a row of small dorsal black spots and smaller lateral ones. Expanse, 31 mm.

Type.—Male, No. 15219, U.S.N.M., Misantla, Mexico, May, 1912 (R. Müller).

Genus AMASTUS Walker.

AMASTUS EDAPHUS, new species.

Head and thorax gray-brown, collar with two black points and a point near base of each patagium; abdomen ocher dorsally, gray below; legs gray, fore tibiæ ocher with blue-gray tips. Fore wing gray-brown, mottled, costa and submarginal area lighter; a narrow indistinct light discal mark, Hind wing ocher, cell and below gray, the gray area running out to outer margin, widening to below vein 3. Expanse, 75 mm.

Type.—Male, No. 15220, U.S.N.M., Tehuacan, Mexico, June, 1912 (R. Müller).

EPIMOLIS, new genus.

Palpi upturned, reaching vertex of head. Fore wing with vein 3 well before the angle of the cell, 4, 5 near the angle, 6 from apex of cell, 7 to 10 stalked, 10 beyond 7, 11 from the cell. Hind wing with vein 2 before angle of cell, 3 and 5 stalked, 4 absent, 6, 7 coincident, long-stalked with 8.

Type-species.—*Epimolis zatrephica*, new species.

EPIMOLIS ZATREPHICA, new species.

Head yellow above, crimson below, the palpi yellow in front; collar yellow; disk purplish, the patagia yellow at base and with a narrow inner crimson edge; abdomen crimson above, white below; fore and mid tibiæ and tarsi yellow with small crimson markings; hind legs white. Fore wing pinkish at basal half with purple tinge, lined with crimson and containing a yellow spot below vein 1; costa and apex yellow, the yellow costa excavate mesially, the apical part extending to submedian fold; a large apical curved mark, resting on vein 5, pinkish, shaded with gray, its veins lined with crimson, containing a yellow spot above; several indefinitely placed small gray spots between the discal venules and a subterminal row. Hind wing crimson, apex and outer margin narrowly yellow, the crimson diffused into the yellow. Expanse, 35 mm.

Type.—Female, No. 15221, U.S.N.M., Misantla, Mexico, June, 1912 (R. Müller).

Digitized by Google

Family PERICOPIDÆ.

Genus PERICOPIS Hübner.

PERICOPIS ZELADON, new species.

Head and thorax dark brown; patagia light yellow on basal third. Abdomen red above with dorsal dark brown stripe; venter light yellow, with lateral brown stripe; legs lined with light yellow. Fore wing dark brown with a broad hyaline V-shaped marking, its apex on tornus, becoming yellow on costa and inclosing a square discal patch; a small projection between veins 4 and 5. Hind wing reddish orange; a submarginal black band containing irregularly shaped powdery whitish spots; discal venules black marked; an outer short, more or less distinctly developed black line, between veins 2–7, or shorter; when present the line is bent outward between veins 4 and 5 and may be preceded by semihyaline patches beyond the discal cross vein. Expanse, 63 mm.

Cotypes.—Seven males, No. 14513, U.S.N.M., Orizaba, Mexico, March and May, 1911, August, 1906 (R. Müller); Jalapa, Mexico (Schaus collection).

Family NOCTUIDÆ.

Subfamily AGROTINÆ.

Genus LYGRANTHOECIA Grote and Robinson.

LYGRANTHOECIA AMBLYS, new species.

Ocherous; thorax olivaceous brown; fore wing olivaceous ocherous; basal and terminal spaces vinous brown, the basal space with a central angle, slightly edged with whitish; a large diffuse dark discal cloud. Hind wing ocherous, shaded with black at base, subcostally and along inner margin; a broad outer black margin; discal mark large, black, semicircular. Expanse, 22 mm.

Cotypes.—Four males, four females, No. 14668, U.S.N.M., Cuernavaca, Mexico, July and August, 1906 (W. Schaus).

The females are a little darker and more contrastingly colored than the males, while the discal mark is square and distinct and of the same vinous brown color as the basal and terminal areas.

Subfamily HADENINÆ.

Genus MISELIA Hübner.

MISELIA TRANSVITTA, new species.

Light gray, minutely irrorate; a black basal dash, forked at its apex; inner line whitish, broadly curved, its termination on inner margin close to that of the outer line, which is similar, whitish, both very indistinct; between them and bordering the inner line is a broad oblique black shade, its lower end truncated by the outer line;

Digitized by Google

discal marks barely discernible, blackish, annular; subterminal line lost, except for a faint whitish speck above tornus; a small terminal, blackish line, the fringe checkered. Hind wing whitish, the veins fuscous lined, apex and outer margin fuscous; fringe pale. Expanse, 22 mm.

Type.—Female, No. 14445, U.S.N.M., Tehuacan, Mexico, August, 1911 (R. Müller).

MISELIA CALOSCOTINA, new species.

Fore wing dark lilacine gray, shaded with blackish; subbasal line slender, black, angled, followed by a light area of the ground; inner line surrounded by blackish shadings which spread out below across the median space to outer line and inwardly nearly to base, the line itself black, double, broadly lunulate in four segments; claviform outlined in black, filled with dark shading; orbicular large, oblique, black-outlined, with central core of dark shading; reniform large, joined to the costa by two blackish streaks, black-outlined except without, a concentric line within, shaded with olivaceous and forming a reddish mark toward the outer side; outer line black, double, the outer segment fainter, shallowly wavy below, incurved above cell to costa above reniform; terminal space heavily mottled and shaded with blackish, in which the broadly waved whitish subterminal line is relieved; some reddish shading over the discal venules; a terminal row of black dashes; fringe blackish with white points at the base. Hind wing fuscous shaded, dark, except from cell to inner margin, where it is faintly yellowish, crossed by dark veins. Expanse, 34–36 mm.

Cotypes.—Two males, No. 14542, U.S.N.M., Zacualpan, Mexico, October, 1911 (R. Müller).

Genus HYSSIA Guenée.

HYSSIA PSEUDOCHROMA, new species.

Reddish ocherous, faintly mottled with brown, a distinct black patch at end of cell over lower half of reniform; inner line faint, brown, coarsely crenulate, the central arc the most distinct; a brown median shade-line, bent at vein 2; outer line crenulate, with a series of long teeth on the veins; subterminal line narrow, yellowish, faint, preceded by a distinct dark shade. Hind wing blackish shaded, the veins black-lined; a small dot on the discal cross-vein. Expanse, 31 mm. Antennæ of male shortly serrate, with bristles and cilia.

Type.—Male, No. 14669, U.S.N.M., Zacualpan, Mexico, November, 1911 (R. Müller).

Genus CIRPHIS Walker.

CIRPHIS STRIGUSCULA, new species.

Rather dark gray; a broad black streak at base below cell; a narrow one below vein 1 above margin from the angle of the wing to

Digitized by Google

the middle; a shorter streak at end of cell, bisected by a small white dot at lower angle of cell; all the veins outwardly black-streaked, the streaks edged on both sides more or less conspicuously with light ocherous; a curved outer row of small black dots; a blackish shading inwardly from apex to about vein 5. Hind wing whitish, a little fuscous along veins and margin, with terminal row of black dots. Expanse, 38 mm.

Type.—Male, No. 14670, U.S.N.M., Misantla, Mexico, December, 1911 (R. Müller).

Genus HADENA Schrank.

HADENA LITHAPHANIA, new species.

Wings long and narrow, the outer margin squarely cut; tornus oblique. Dark gray, a little shaded with blackish; subbasal and inner lines blackish, geminate, slender, obscure; claviform partly outlined in black; orbicular large, elliptical, oblique, pale yellowish, sharply but incompletely edged, with a central dark line; reniform elliptical, of the ground color with a little bronzy tint, black-edged within, with inner crescentic line; outer line blackish, double, crenulate, not contrasted; subterminal line macular, brown, coarsely waved; terminal row of black dashes; fringe pale at base. Hind wing nearly solidly black, the fringe contrastingly pale with central dark line. Expanse, 33–38 mm.

Cotypes.—Male and female, No. 14543, U.S.N.M., Zacualpan, Mexico, October, 1911 (R. Müller).

Genus ERIOPYGA Guenée.

ERIOPYGA LOLIOPOPA, new species.

Brown-gray; fore wing with the subbasal half-line slender, whitish, dark-edged within; inner line straight, slightly oblique, whitish, edged with dark brown without; claviform, orbicular and reniform large whitish rings, the claviform without any dark inner edging and consequently less contrasted than the other two stigmata; median shade-line slender, dark brown, running between the discal stigmata, a little bent in the cell; outer line whitish, bent subcostally, edged with dark brown within, the edging broken on the veins, a row of dark-brown dots without; terminal field darker, more densely irrorated with brown than the rest of the wing, crossed by the slender whitish subterminal line, which is well contrasted; a terminal brown band, cut by paler veins into checkered pattern. Hind wing soiled yellowish whitish over the disk, the margin broadly fuscous; veins darker. Expanse, 30–32 mm.

Cotypes.—Two males, No. 14544, U.S.N.M., Zacualpan, Mexico, September, 1909 (R. Müller).

Digitized by Google

ERIOPYGA CRACERDOTA, new species.

Dark gray, with slight brown tint; fore wing with the subbasal half-line slender, whitish; inner line straight, slightly oblique, whitish, narrowly and obscurely dark-edged without; claviform absent; orbicular and reniform large whitish rings, the orbicular slightly oblique, the reniform incised without; median shade-line slender, dark, bent in the cell between the stigmata; outer line whitish, sharply bent beyond the cell, followed by a row of square dark-brown dots; subterminal line straight, whitish, distinct; a row of dark marginal dots, cut off by slender pale crescents. Hind wing shaded with fuscous, a little lighter toward base; veins dark. Expanse, 30–31 mm.

Male with long sparse hair on the cell of fore wing beneath; antennæ finely ciliate; side pieces of genitalia rather conspicuously covered with dark yellowish hairs.

Cotypes.—Three males, one female, No. 14545, U.S.N.M., Zacualpan, Mexico, August, 1909; September and October, 1911 (R. Müller).

ERIOPYGA CRENULATA Butler.

This species occurs in the eastern part of North America to the plains. Hampson[1] gives also localities in Mexico, Central America, and southward. This southern form is distinct from the northern *crenulata*, being a larger, heavier species, with coarse and more prominently angled markings. The male anal tuftings are less developed, the pale hairs being absent and they are apparently less extensible. On the under side of the fore wing of the male the down-curved hairs extend below the cell and are not confined to the area in and beyond it, as Hampson correctly figures for *crenulata* (fig. 74). The typical form of this southern species occurs in Mexico, Central America, Venezuela, and Ecuador. To the southward smaller, less strongly marked forms occur; whether species or races can not well be decided from the present material. They are separately described below.

ERIOPYGA VESQUESA, new species.

Large, robust, the male with the down-curved hairs on fore wing below extending below the cell. Purplish brown, the lines pale, fine; subbasal half-line slightly curved; inner line oblique, dislocated in cell, preceded by black dots on vein 1; orbicular and reniform both large, oblique, pale-outlined; outer line roundedly angled at right angles on upper third, followed by a row of indistinct double black dots; subterminal lines erect, nearly straight, the terminal space appearing a little paler, with distinct crenulate pale marginal line. Hind wing dark brown, the veins darker, fringes pale. Expanse, 35–40 mm.

[1] Cat. Lep. Phal. Brit. Mus., vol. 5, 1905, p. 320.

Digitized by Google

Cotypes.—Two males, two females, No. 15222, U.S.N.M., Loja, Ecuador, 1890 (P. Dognin); Aroa, Venezuela (Schaus collection); Cordoba, Mexico, May, 1906 (W. Schaus).

ERIOPYGA OACHE, new species.

Smaller than the preceding, grayer, less intensely colored, the bend in the outer line making a less acute angle, but all the markings the same as in *vesquesa*. Expanse, 30 mm.

Cotypes.—One male, one female, No. 15223, U.S.N.M., Peru (Schaus collection).

ERIOPYGA ULTIMELLA, new species.

Small, shining light gray-brown, the markings little relieved and difficult to trace, all essentially as in the preceding form, but here the crenulate marginal line seems wholly lost. The hind wings are a light, duller brown, and, especially in the male, show a whitish suffusion over the disk. Expanse, 28–34 mm.

Cotypes.—One male, two females, No. 15224, U.S.N.M., Rio de Janeiro and Castro, Parana, Brazil (Schaus collection).

ERIOPYGA LANARIS Butler.

This species has much the same markings as the preceding forms, the outer line being less prominently angled. The male is easily recognized by the rough scaling on the wings below, which involves the hind wings. Females are less easy to determine, and certain small specimens before me were named *lanaris* by authority. However, I now possess a male with very different secondary sexual characters, agreeing in size and markings with the females. It is described below as *E. enages*. I have also from Peru a single male, closely resembling *lanaris* above, but without rough scaling on the hind wings. It may be described as

ERIOPYGA DOLIA, new species.

Large, robust, the tegulæ with black tips; reddish brown, the lines pale, slender; basal half-line curved; inner line sharply angled on subcosta and submedian; a rusty brown costal shade beyond to submarginal line; orbicular and reniform large, oblique, pale ringed; mesial shade line oblique, dark; outer line obtusely angled subcostally, followed by two rows of black dots; submarginal line erect, faint. Hind wing gray-brown with dark veins and pale fringe. Male with rough scales over the whole of the fore wing below, except the margins, but none on the hind wing. Expanse, 37 mm.

Type.—Male, No. 15225, U.S.N.M., Peru (Schaus collection).

ERIOPYGA ENAGES, new species.

Markings as in *E. crenulata* Butler (North American), the male secondary sexual characters as in *E. cynica* Guenée. Grayish brown,

Digitized by Google

the lines pale, faint. Orbicular rather small, oblique; reniform very little constricted; outer line bent very nearly at right angles; no marginal crenulate markings. Expanse, 29 mm.

Type.—Male, No. 15226, U.S.N.M., Misantla, Mexico, March, 1912 (R. Müller).

The females, above referred to, are redder than the male type, the orbicular is larger and more distinctly oblique, the reniform is well constricted and the outer line is not bent at a right angle. On account of these differences they have not been made cotypes, although I think it probable that the differences are varietal only.

Eight females, Orizaba, Mexico, February, 1911, April and May, 1910, October, 1908, November, 1910 (2), December, 1911 (R. Müller); Coatepec, Mexico (Schaus collection).

Subfamily CUCULLIINÆ.

Genus MOMAPHANA Grote.

MOMAPHANA SYLVIA, new species.

Thorax green, the patagia and tegulæ tipped with white; a white band behind the middle. Abdomen shaded with green, the tuft on the basal segment dark-tipped. Fore wing with the ground white, largely overlaid with rich grass-green; a small black mark on costa close to base, edged with white; lines converging below and uniting at vein 1, the median space filled with black below up to or in the cell between the stigmata, the lines themselves forming part of this black and brown mesial wedge, which is truncated below at vein 1, notched within on median vein and coarsely scalloped without; orbicular very large, green, more or less completely white-ringed; reniform large, variously constricted, white, with green shades encroaching on it above and below; the median triangle is broadly edged with white within, narrowly so without; terminal field green, the subterminal line white narrow, broken, with a black mark on costa, a broad adjoining white shade below, then a black wavy inner border, sagittately produced on vein 2 and with a brown streak outward to tornus; fringe white and green, with black tips to the green segments; costa spotted black and white. Hind wing white, silky, semihyaline, a little shaded with green around apex. Expanse, 40–44 mm.

Cotypes.—Seven males, five females, No. 14514, U.S.N.M., Southern Arizona (J. Doll); Tehuacan, Mexico, June and October, 1911 (R. Müller); Guadalajara, Mexico (Schaus collection); Zacualpan, Mexico, September, 1911 (R. Müller); Cuernavaca, Mexico, June, July, August, 1906 (W. Schaus), November, 1911 (R. Müller).

The species is allied to *Momaphana brillians* Barnes from Arizona, though obviously distinct.

Digitized by Google

MOMAPHANA ARNADORA, new species.

Fore wing nearly entirely overlaid with green, presumably of a grass-green, but faded to yellowish in the specimen by wetting in the relaxing-jar. The markings are of the pattern of the preceding species, but the median black space is very wide, showing a broad area beyond the reniform, broad below and broadly truncate on vein 1; no white edging within, a very narrow one without; orbicular small, green; reniform large, square, constricted, green with a small white crescent in the center and narrow white edge below; space beyond solidly green except for the white subterminal line, which has no accompanying white shades but only a black costal mark and a three-pronged black triangle below; the streak from this to tornus is black-brown, short and thick; costa narrowly black and white spotted. Hind wing white, silky, semihyaline. Expanse, 36 mm.

Type.—Female, No. 14515, U.S.N.M., Tehuacan, Mexico, August, 1911 (R. Müller).

Subfamily SARROTHRIPINÆ.

Genus BAILEYA Grote.

BAILEYA RESTITANS, new species.

Gray, washed with whitish through the center of the wing; basal area, broad on inner margin, dark ocher with a white outer edge and a black costal bar; inner line lost; stigmata lost, the reniform showing a little as a spot in an irregular dark mesial line; a brown-black triangular costo-apical marking cut vertically by white, the outer section nearly trisected longitudinally by white; from this the slender irregularly wavy black outer line, followed by white and near inner margin by a short roundedly dentate black line; terminal veins slightly dark-lined. Hind wing fuscous, a little lighter on the disk, the veins finely black-lined. Expanse, 29 mm.

Type.—Female, No. 14546, U.S.N.M., Orizaba, Mexico, July, 1908 (R. Müller).

This species has the size of *B. ophthalmica* Guenée, but the markings are as in *B. australis* Grote.

Subfamily ACRONYCTINÆ.

Genus BAGISARA Walker.

BAGISARA OULA, new species.

Thorax and fore wing shining whitish gray, without yellow tint, shading to brown at outer margin, the fringe the darkest; three fine slender lines, the inner one far out, bent at right angles subcostally; middle line more strongly bent, running into a point at vein 6; outer line bluntly bent, curved only. Hind wing creamy whitish with pale brown shading outwardly. Abdomen like the hind wing, with dorsal brown shading. Expanse, 33 mm.

Cotypes.—Three females, No. 14428, U.S.N.M., Jalapa, Mexico (Schaus collection).

Digitized by Google

BAGISARA DEMURA, new species.

Ocher yellow, the fore wing with a faint brownish tint, smooth, silky, not irrorate; fringe brown; lines slender, brown, not waved; inner line bent and an obtuse angle on subcosta; outer line bent at right angles on vein 7; subterminal line similarly bent but less sharply. Expanse, 30 mm.

Cotypes.—Male and female, No. 14442, U.S.N.M., Guadalajara, Mexico (Schaus collection); Misantla, Mexico, August, 1911 (R. Müller).

BAGISARA XAN, new species.

Ocher yellow, the fore wing with a faint brownish tint, smooth, silky, with sparse brown irrorations; fringe dark brown, the color spreading inward centrally across the subterminal line; lines slender, brown, not waved; inner line curved on subcostal; slight trace of an annular reniform; outer line bent at an acute angle on vein 7; subterminal line similarly bent at right angles, the lower segment arcuate. Expanse, 39 mm.

Type.—Female, No. 14443, U.S.N.M., Orizaba, Mexico (Schaus collection).

Genus PERIGEA Guenée.

PERIGEA SUTRIX, new species.

Gray, with ochraceous tint, smooth, lustrous, silky; markings black, all broken and powdery, more or less obsolete; inner line single with a strong indentation at vein 1; a black shading at the point of the claviform; a more extensive shading between the discal stigmata and surrounding the lower part of the reniform; the stigmata are themselves principally outlined by this shade, ocherous, with powdery dark centers, the orbicular elliptical, a little oblique the reniform large, emarginate without; outer line a double series of points, the two rows well separated; subterminal line edged within by a black shade more or less distinctly, in one specimen strongly so. Hind wings creamy white in the male, fuscous in the female, the fringes pale. Expanse, 32 mm.

Cotypes.—Two males, two females, No. 14671, U.S.N.M., Misantla, Mexico, January, 1909, June and August, 1910 (R. Müller); Oaxaca, Mexico (Schaus collection).

Very near *P. sutor* Guenée, but differing in detail, the hind wings of the male especially being much paler.

PERIGEA PYROMPHALUS, new species.

Rosy gray, with more or less orange shading over center of wing; lines double, dark, indistinct, crenulate, the outer forming a series of minute points beyond; orbicular small, round, orange tinted, with

Digitized by Google

brown border and concentric ring; reniform narrow, containing bright orange center, a white point at its lower edge continued into a fine line and a point at the upper edge; a brown central crescent; a blackish shade follows the reniform up to the outer line; subterminal line black, waved, broken into a series of spots, of which the lower one is large and rounded. Hind wing blackish fuscous, the fringe pale. Expanse, 28 mm.

Cotypes.—Two males, No. 14672, U.S.N.M., Misantla, Mexico, April and November, 1911 (R. Müller).

Genus MICRATHETIS Hampson.

MICRATHETIS DASARADA Druce.

This small, narrow-winged species shows a tendency to local forms in its wide distribution. The Mexican form shows in general a light straw-colored ground, without marked olive-brown shades, the outer spot at the end of the cell large and round. Costa Rican examples before me show marked olive-brown shading within the oblique outer line, especially in females, while the discal dot is minute or absent. In Brazilian females this tendency is more pronounced, the purplish shading being more uniform over the wing, the discal mark nearly invisible. Specimens from the Guianas are smaller, the dark shading forming a band through the center of the wing, leaving the cell and terminal areas pale straw-color. The outer band is less oblique than in *dasarada*. For this form the varietal name *dacula* may be suggested. Cotypes of the form *dacula*, No. 14673, U.S.N.M., five males, eight females, St. Jean, Maroni River, French Guiana; 60 miles up the Maroni River (one female); Demerara, British Guiana (one female), all from Mr. Schaus's collection.

Genus MENOPSIMUS Dyar.

MENOPSIMUS CADUCUS Dyar.

Menopsimus caducus DYAR, Journ. N. Y. Ent. Soc., vol. 15, 1907, p. 110.
Thalpochares fractilinea SMITH, Ann. N. Y. Acad. Sci., vol. 18, 1908, p. 125.

This species is not known to extend its range to Mexico, but is mentioned in this connection on account of its very similar facies to the preceding species and to the following new genus. I described *Menopsimus* as a deltoid genus, but according to Sir G. F. Hampson's tables it falls in the Acronyctinæ. The venation is as follows: Fore wing with veins 2 and 3 before the angle of the cell, 5 well above the angle, 6 below the upper angle, 7 curved to costa, 8 and 9 stalked, 10 absent, 11 from the cell, no accessory cell; hind wing with vein 2 well before the angle of the cell, 3 and 4 stalked, 5 very weak, from the middle of the discocellulars to an excavation in the outer margin, 6 and 7 stalked, 8 joined to the cell for nearly the basal half.

Digitized by Google

The genus falls in Hampson's table [1] with *Nolasodes* Hampson, and with the following, the three being easily separated by the structure of the palpi.

HYPENOPSIS, new genus.

Fore wing with veins 2, 3, and 4 well separated, 5 arising shortly above the angle of the cell, 6 below the upper angle, 7 running to the outer margin, 8, 9, and 10 stalked, all running to the costa, no accessory cell, vein 11 from the discal cell; hind wing with vein 2 long before the angle of the cell, 3 and 4 stalked, 5 very weak, from the middle of the discocellulars to an excavation in the outer margin, 6 and 7 stalked, 8 free from the cell to base. Palpi with the second joint a long thick blade, twice as long as the head, porrect, the third joint long, very slender and standing upright.

Type-species.—The following species:

HYPENOPSIS MACULA Druce.

Hypenodes macula DRUCE, Biol. Cent.-Am., Lep. Het., vol. 1, 1891, p. 441, pl. 86, fig. 1.

Described from two specimens from Chiriqui, Panama. I have before me thirteen from Jalapa and Orizaba, Mexico, one from São Paulo, S. E. Brazil, one from Castro, Parana, Brazil, all from Mr. Schaus's collection, and four from La Puerta Valley, near San Diego, California, from Mr. G. H. Field.

Genus HYDROECIA Duponchel.

HYDROECIA ARNYMAI, new species.

Rufous yellowish, marked with red-brown; base of fore wing dark, the subbasal line broad, pale; inner line of three brown arcs, outwardly oblique; claviform a half of a brown ringlet in a pale area; orbicular round, pale, its border blending with the dark ground surrounding; a dark shade-band across middle of wing, angled on median vein, darker than the general ground color; reniform pale with faint dark concentric center; outer line single, crenulate, excurved over cell, terminating the brown-irrorate median area; a rounded brown patch on costa; subterminal line of three long shallow arcs, the terminal space solidly brown; fringe dark. Hind wing reddish brown, the veins a little darker, discal area somewhat yellowish between the veins. Expanse, 26 mm.

Type.—Male, No. 14674, U.S.N.M., Zacualpan, Mexico, December, 1911 (R. Müller).

[1] Cat. Lep. Phal. Brit. Mus., vol. 9, 1910, p. 2.

Digitized by Google

Genus NOCLOA Smith.

NOCLOA PERIODITA, new species.

Thorax purple-gray; vertex of head yellow. Fore wing nearly entirely suffused with purple-gray; two light yellow lunules below the median vein, representing undulations of the obsolete inner line; orbicular and reniform large, but showing faintly by their slightly lighter, yellowish inner borders; outer line even, dentate on the veins, relieved only by the broad following yellow area, irrorated with red, which is cut by purple on the veins and succeeded by the purple-gray margin. Hind wing purplish fuscous, a little lighter along the veins, showing faintly a dark discal spot and outer mesial line. Expanse, 30 mm.

Type.—Female, No. 14440, U.S.N.M., Tehuacan, Mexico, August, 1911 (R. Muller).

Genus CHALCOPASTA Hampson.

CHALCOPASTA CHALCOCRASPEDON, new species.

Thorax purple-brown; vertex and collar ocherous. Fore wing purple-brown, the basal and terminal spaces solidly metallic bronzy; extreme base purple; beyond it to inner line bronze; inner line bent at right angles in the middle, dark, single, not contrasted; orbicular large, bronze filled; reniform lost, only a slight bronzy discoloration; outer line outwardly oblique from costa, bent at an acute angle, then nearly straight to middle of inner margin, the space beyond to fringe solidly bronze, except the costal triangle; fringe purple. Hind wing pale fuscous with a broad lighter band beyond the middle. Expanse, 30 mm.

Type.—Female, No. 14441, U.S.N.M., Zacualpan, Mexico, September, 1911 (R. Müller).

Subfamily ERASTRIINÆ.

Genus TARACHIDIA Hampson.

TARACHIDIA HEONYX, new species.

Pure white; outer half of fore wing brown, the line dividing the colors straight, starting near middle of inner margin, running a little obliquely outward almost to costa, then bent at nearly right angles obliquely outward, and again angled and reaching costa just before apex. Abdomen and hind wing yellowish white, the wing faintly fuscous tinted on the margin; fringe pale. Expanse, 20 mm.

Type.—Female, No. 14438, U.S.N.M., Cerritos, San Luis Potosi, Mexico, August, 1911 (R. Müller).

Digitized by Google

Genus EUSTROTIA Hübner.

EUSTROTIA MOCHENSIS Schaus.

Photedes mochensis SCHAUS, Trans. Amer. Ent. Soc., vol. 30, 1904, p. 157.
Micromonodes mochensis HAMPSON, Cat. Lep. Phal. Brit. Mus., vol. 8, 1909, p. 565.
Monodes cassida DYAR, Proc. U. S. Nat. Mus., vol. 43, 1912, p. 64.

Having found a number of specimens of this species in the Schaus collection, and having recently received others from Mr. Müller, I have been able to examine carefully the venation. There are two important errors in Hampson's figure, namely, that vein 5 of the hind wing is really strong and distinct, not weak, as there shown, and there is a small accessory cell present on the fore wing, joining vein 10 to the stalk of veins 7 to 9. The correction of these matters will place the species in the Erastriinæ and in the genus *Eustrotia*. The species is not very similar to the other species of *Eustrotia*, but I do not detect any characters for generic separation. It will fall in the section with *E. chuza* Druce by the long third joint of the palpi.

EUSTROTIA PULMONA, new species.

Photedes pulmona SCHAUS, MS.

Dark reddish gray; fore wing with distinct black mesial band, angled a little centrally; a black dot in the cell and lunule at end of cell; lines slender, black, the inner angled outwardly in the middle, the outer angularly excurved, neither conspicuous, the outer with little light specks along its course; a row of many black strigæ along the costa; a fine crenulate terminal black line, with light specks in the excavations. Hind wing blackish to nearly black, with an outer mesial lighter line and a faint inner darker one, the fringe reddish, with terminal line as on fore wing. Expanse, 27 mm.

Cotypes.—Male and female, No. 14675, U.S.N.M., selected from a series, Jalapa, Mexico (Schaus collection).

The palpi have the third joint long as in *E. mochensis* Schaus, to which the present species is allied.

Genus DIASTEMA Guenée.

DIASTEMA PANTELES, new species.

Gray, with a very slight rosy tint; base light, but a blackish shading on the costal half of the extra-basal space; inner line dark, arcuate, confused by the stigmata, the claviform and orbicular forming pale ellipses beyond it and small pale segments within; these marks project into a deep black shade that runs from the costa a little obliquely and stops at the claviform; reniform large, elliptical, a narrow black ring filled by the ground color with an inner brownish concentric line, the black rim fused to the median shade; outer line blackish, crenulate, fine and faint; subterminal line twice angled above and edged

Digitized by Google

within by a deep black shade, incurved below at submedian and without the black shade; three black streaks above across the terminal space; a row of black terminal dashes in a light line. Hind wing brownish gray, streaked with blackish on the veins on the lower half; a terminal fuscous line. Expanse, 30 mm.

Type.—Female, No. 14439, U.S.N.M., Tehuacan, Mexico, September, 1911 (R. Müller).

Subfamily EUTELIINÆ.

Genus EUTELIA Hübner.

EUTELIA AMATRIX, new species.

Light reddish, area between veins 1 and 2 and at apex slaty gray; a brown half-band at basal third of inner margin, edged by a whitish line, which shows most distinctly in an arc between veins 1 and 2, limiting the gray area; a reversed white arc beyond, the gray shade running upward submarginally; terminal area narrowly red-brown below, widening above the bend in outer margin, limited by a white arc which joins an oblique line running to costa; gray apex cut off by a whitish line; discal mark pale, lunate, clouded. Hind wing white; a broad outer black band, shading to red on the margin. Expanse, 32 mm.

Type.—Female, No. 15227, U.S.N.M., Iguala, Guerrero, Mexico, June, 1906 (W. Schaus).

Subfamily CATOCALINÆ.

Genus CELIPTERA Guenée.

CELIPTERA SURRUFULA, new species.

Fore wing soft gray, slightly violaceous in tone; inner line shaded black, coarsely angulated, upright; discal mark narrow, curved; outer line crenulate, with whitish specks in the undulations, shaded, a large cloud opposite the cell and one on submedian; the line is marked on costa, then slender, excurved over cell; subterminal line a row of black dots; a terminal row of short dashes. Hind wing reddish gray, with terminal short black dashes. Expanse, 36 mm.

Type.—Male, No. 14498, U.S.N.M., Cerritos, San Luis Potosi, Mexico, August, 1911 (R. Müller).

Genus ZALE Hübner.

ZALE RHIGODORA, new species.

Dark brown, smooth and uniform, without contrasts; basal space of fore wing darkly mottled, obscurely strigose with black, its outer edge sharply and roundedly limited from inner third of costa to near base of inner margin; no limiting line, but a slight following light purplish shade; costa with narrow pale streaks; reniform scarcely

Digitized by Google

darker than the ground, moderate, narrowly white-edged without; outer line black, slender, tremulous, obscure, excurved centrally, with a small black spot within above vein 4, narrowly white-marked on costa; subterminal line distinct, outcurved in the middle, forming two inward arcs, limiting the dark median space, but scarcely itself a line; black shadings from the projection to the outer margin, completing the lower arc and cutting off a lunate space around tornus, which is purplish shaded and marked with a small white spot in the submedian space; margin crenulate. Hind wing colored like the fore wing, with many fine wavy transverse blackish lines; submarginal line curved, cutting off a broad lunate space on the margin, itself brown, double, the marginal space lightened with purplish. In the female the light purplish shades are absent, their places being taken by blackish shades bordering the lunate areas. Expanse, 45 mm.

Cotypes.—Three males, three females, No. 14516, U.S.N.M., Misantla, Mexico, January and September, 1911 (R. Müller).

Subfamily NOCTUINAE.

Genus CAMPOMETRA Guenée.

CAMPOMETRA DISTILLA, new species.

Thorax dark, blackish, the disk intermixed with white scales, the collar brownish in front. Fore wing with the ground color gray, with a slight olivaceous tint, overspread with blackish shades; base darkly shaded, the subbasal line black, fine, dentate, relieved by narrow lighter shades; inner line similar, the ground color appearing on both sides of it; orbicular a black dot; mesial line black, irregular, shaded toward base and with an outward duplication, which is distinctly present on the right wing of the specimen and not on the other; reniform marked by a white speck on each of the four corners, the two outer ones joined by a white lunule; a blackish rounded patch on costa above, marked with white before and behind, the outer followed by blackish and another white streak; other line slender, black, dentate, followed by a bluish-black dentate shade; a light shade of the ground color through middle of wing; subterminal line dentate, black, with an outward shaded duplication; a row of black dashes close to the margin preceded by white specks; a terminal wavy black line followed by white specks at the base of the fringe. Hind wing blackish, solidly black on costal third with a bronzy luster; several series of black and gray specks over the disk; a black dentate subterminal line with outward duplication, not crossing costal third; terminal markings as on fore wing. Expanse, 48 mm.

Type.—Female, No. 14436, U.S.N.M., Misantla, Mexico, August, 1911 (R. Müller).

Digitized by Google

Genus MATIGRAMMA Grote.

MATIGRAMMA PSEGMAPTERYX, new species.

Soft bluish gray, dark in tone; lines blackish, wavy, not contrasted, forming about ten dark specks along the costa; inner and median lines slender, waved; a dot toward base of cell; reniform a large, kidney-shaped pale area; outer line a little more distinct than the others, edging the pale reniform, broken below but joined by a line from costa within reniform; three wavy lines between reniform and margin, the inner one shaded and forming an enlargement below vein 2; a waved terminal dark line; fringe crossed by light streaks. Hind wing of the same color as fore wing, crossed by seven indistinct waved dark lines, the subterminal one a little the most distinct and well scalloped; fringe as on fore wing. Expanse, 32 mm.

Type.—Female, No. 14437, U.S.N.M., Cerritos, San Luis Potosi, Mexico, August, 1911 (R. Müller).

Genus PROTHYMIA Hübner.

PROTHYMIA CATAPLEXIS, new species.

Yellow; vertex, sides of front and bases of patagia crimson. Fore wing yellow; costa crimson on basal half, the crimson band notched beneath; outer half of wing crimsom, the inner border oblique and a little irregular, the crimson area inclosing a yellow triangular area on inner margin. Hind wing fuscous tinged. Beneath, fore wing dark gray, crimson tinged toward apex. Hind wing whitish. Expanse, 19 mm.

Type.—Female, No. 14517, U.S.N.M., Sierra de Guerrero, Mexico, October, 1911 (R. Müller).

Genus PLEONECTYPTERA Grote.

PLEONECTYPTERA IGNILINEA, new species.

Fore wing dark violeceous gray, the two lines nearly straight, parallel, dark, shaded with coppery red, the outer with a following pale border in which the red tint prevails; reniform outlined in dark faintly; subterminal space darker, purplish, irregularly limited outwardly by the paler marginal area; narrow dark terminal dashes. Hind wing lighter than fore wing, but of the same general tone; traces of a mesial darker line. Expanse, 25 mm.

Type.—Female, No. 14547, U.S.N.M., Tehuacan, Mexico, August, 1910 (R. Müller).

Genus PANGRAPTA Hübner.

The following species are placed provisionally in this genus. The specimens are all females.

Digitized by Google

PANGRAPTA ALOPOPIS, new species.

Dark lilacine brown; reniform elliptical, with a white crescent on the inner border, a minute white dot at upper and lower edges, a dark-red stain and white specks in the center; inner line coarsely dentate, broken, blackish, followed by the black punctiform orbicular; outer line white at its inception on costa, then blackish, dentate, outcurved over cell; a following dusky shade above; subterminal line faint, dark, clouded with blackish on costal fourth; a row of minute terminal black dots. Hind wing of the same color as fore wing and similar pattern; a large rust-red discal stain; mesial line blackish, dentate; subterminal line whitish, obscure; terminal dots as on fore wing. Expanse, 23 mm.

Type.—Female, No. 14495, U.S.N.M., Misantla, Mexico, August, 1911 (R. Müller).

PANGRAPTA HERBITECTA, new species.

Fore wing with a rounded projection at the middle of the outer margin; lilacine gray; two black specks near base for subbasal line; inner line coarsely wavy, pale, brokenly edged with black; orbicular round, small, green; median shade with a brown-black triangle on costa, thence continued faintly across wing; reniform brown-filled, stained with green; outer line whitish, narrow, distinct, not waved, excurved over cell, relieved on a dark ground; a large brown-black costo-subapical triangular patch with green below, between it and the subterminal line; subterminal line obscure, pale; a row of minute terminal dots; a larger spot below the marginal angle. Hind wing with a small point on the middle of the margin; gray, like the fore wing; a large green stain on the middle of the inner margin between the faint mesial and outer lines. Expanse, 19–21 mm.

Cotypes.—Two females, No. 14496, U.S.N.M., Misantla, Mexico, September, 1911 (R. Müller); Orizaba, Mexico (Schaus collection).

Genus GLYMPIS Walker.

GLYMPIS PHOENICIMON, new species.

Rufous-brown; fore wing with two straight light ocherous lines; a small spot in cell and one at end darker brown; a subterminal row of brown specks situated in a light line, which in some specimens is more distinct than the specks; area between the outer line and subterminal specks sometimes darker than the rest of the wing. Hind wing of the male slightly tinged with rufous outwardly, the long pencil in a fold along anal margin black. In the female the hind wing is strongly tinged with bright rufous outwardly. Expanse, 25–27 mm.

Cotypes.—No. 14676, U.S.N.M., male, Cuernavaca, Mexico (Schaus collection); female, Zacualpan, Mexico, December, 1911 (R. Müller); two females, Cuernavaca, Mexico (Schaus collection).

Digitized by Google

Family NOTODONTIDÆ.

Genus DASYLOPHIA Packard.

DASYLOPHIA RUFITINCTA, new species.

Male.—Thorax reddish brown; collar clayey yellow. Fore wing bright reddish brown, the color extending below vein 2 to the tornus, but a little lighter at base and defined by a faint curved dark line near middle of wing; this line seems to be incised at median vein and to run obliquely across median space to near base of wing, but is very faintly relieved; apex broadly blackish shaded, the veins black-lined, with dark gray streaks between them, separated from the veins by pale ocherous lines; a series of oblique black streaks on the margin, the two between veins 2 to 4, more distinct, more inwardly placed, and with ocherous crescents. Hind wing soiled white, the veins touched with gray outwardly and a gray shade at anal angle. Expanse, 40 mm.

Female.—Ground color of wing more ocherous, with less red tint than in the male; basal area ocherous, rounded without, incised on median vein and powdered with dark scales, especially toward the base; outer area shaded with dark brown, the cloudings forming two ill-defined oblique bands, the apex wholly dark; veins black-lined beyond the cell; terminal markings faint, only the pale crescents between veins 2 to 4 showing. Hind wing soiled white, a terminal brown line, the fringe a little brown shaded. Expanse, 46–51 mm.

Cotypes.—Two males, two females, No. 14466, U.S.N.M., Orizaba, Mexico, September, 1911 (R. Müller); Cordoba, Mexico, December 26–28, 1907 (F. Knab); May, 1906 (W. Schaus).

The species has the wings unusually long and narrow; the hair-whorls at the bases of the antennæ are short and do not become confluent to form the high vertical tuft characteristic of the genus.

The specimens show some individual diversity. The male from Orizaba is described above. The male from Cordoba is much less distinctly marked. Its color is the same, but the dark apical shading is much less noticeable. Of the females, the one collected by Mr. Knab I consider typical. The other is a little larger and darker, with the shadings heavy and extensive, crossing the basal light space and almost wholly obscuring the submarginal lunate marks.

CALOMATHETES, new genus.

Fore wing with a tuft of scales on inner margin and one before anal angle; outer margin crenulate; no areole; veins 8–10 stalked; antennæ of male lengthily bipectinated to the tip.

Type-species.—The following species:

CALOMATHETES HALMAPHYLLA, new species.

Fore wing yellowish brown, broadly shaded with purplish beyond the outer line; a few black specks and streaks near the base; inner

Digitized by Google

line composed of a series of elongate black dots in three irregular rows, curving across the wing, forming a slender line above the tooth on inner margin; the basal space has a slight purplish washing; mesial space lighter, especially just before the outer line, a little diversified with brownish lines, a trace of reniform mark and a black streak on discal fold; outer line double, composed of two series of black crescents alternating with whitish ones, obliquely from before the outer tooth on inner margin to costa before apex; traces of a subterminal line in the purplish marginal shading, which expires at apex; veins dark-lined at the margin; a row of purple-white spots in the projections of the fringe. Hind wing fuscous shaded, the veins darker, the fringe contrastingly pale. Expanse, 42 mm.

Type.—One male, No. 14465, U.S.N.M., Tehuacan, Mexico, September, 1911 (R. Müller).

Genus PSILOCRON Felder.

PSILOCRON APHRETHESA, new species.

Thorax gray, intermixed with olive; abdomen blackish dorsally, except the last segment, which is pale gray. Fore wing pale gray, almost whitish at base and along basal half of costa, shaded with olive toward apex (faded to brownish in the specimen); base narrowly olive gray; lines olive gray, double, the inner broken and obsolescent across cell, distinct below, with a strong inward projection on submedian fold; a small olive mark in center of cell and a larger one at the end, both lunate; outer line faint costally, geminate, crenulate, slightly excurved over cell, followed by a row of olive-gray spots; subterminal line whitish, irregular, not contrasted; veins terminally dark-lined. Hind wing grayish, the disk translucent, costa whitish with two gray bars; termen blackish, fringe whitish, inner margin broadly shaded with blackish except at tornus. Expanse, 50 mm.

Type.—Male, No. 15228, U.S.N.M., Misantla, Vera Cruz, Mexico, March, 1912 (R. Müller).

The species looks like a *Heterocampa*, allied to *H. atrax* Schaus and *H. dolorosa* Schaus.

Genus FARIGIA Schaus.

FARIGIA MALOMEN, new species.

Female.—Ground color light gray with a carneous tint, powdered with blackish and marked with powderings and patches of metallic green; ordinary lines blackish, geminate, obscured by shadings; a subterminal row of partly confluent black dashes; a broken black bar along submedian fold from base to outer line; a black shading occupying the inner half of median space, covering and partly obscuring the inner line; discal mark narrow, black-outlined; a narrow deep black shade covering and filling the outer line. Hind wing brown, not quite uniformly colored. Expanse, 50-52 mm.

Digitized by Google

Cotypes.—Two females, No. 15229, U.S.N.M., Cordoba, Mexico, May, 1906 (W. Schaus); Misantla, Mexico, May, 1912 (R. Müller).

The following table will separate the five species of *Farigia* known to occur in Mexico:

Sexes dimorphic; antennæ of female bipectinate; male with raised whitish discal mark.....*montana* Druce.
Sexes monomorphic; antennæ of female simple; male with discal mark, if present, dark.
A black shade from base of fore wing below cell bordering the subterminal line, *hydriana* Schaus.
Black shade over median space in lower half of cell to inner margin, not crossing outer line.....*magniplaga* Schaus.
No broad black shades.
Outer line, inner half of median space and submedian streak narrowly black shaded.....*malomen* Dyar.
No black linings except the ordinary markings.....*vecina* Schaus.

It seems possible that the four forms *hydriana*, *magniplaga*, *malomen*, and *vecina* may prove to belong to one variable species since they differ only in the black shadings and not in pattern.

Family GEOMETRIDÆ.

Genus OENOTRUS Druce.

OENOTRUS MELANODORA, new species.

Black; collar, patagia, orbits, palpi and fore coxæ, orange; wings black, the tip of fore wing white and on fringe at apex. Beneath as above, the apex of fore wing and the hind wing leaden black, with the veins deep black. Expanse, 28 mm.

Type.—One male, No. 14301, U.S.N.M., Sierra de Guerrero, Mexico, June, 1910 (R. Müller).

OENOTRUS BIPENNIS, new species.

Black; vertex and disk of thorax orange yellow; a large patch of this color on fore coxa; wings black, the extreme base of forewing orange red, the color extending out farther on costa and inner margin. The forewing is more brownish black than the hind wing; beneath both wings bluish black. Expanse, 34 mm.

Type.—One male, No. 14302, U.S.N.M., Sierra de Guerrero, Mexico, June, 1910 (R. Müller).

The forewings are longer and more drawn out than usual.

Genus HYDRIOMENE Hübner.

HYDRIOMENE POTOSIATA, new species.

Palpi short, upturned, reaching the middle of the front. Forewing fuscous, a little washed with whitish from the cell to before apex; an irregular black line from the origin of vein 2, continued by a black

Digitized by Google

shade to apex; a black mark beyond middle of inner margin; indications of transverse lines across the wing, apparently numerous and double but scarcely legible; veins black-lined close to the margin. Hind wing uniform brownish fuscous. Expanse, 24 mm.

Type.—One female, No. 14459, U.S.N.M., Cerritos, San Luis Potosi, Mexico, August, 1911 (R. Müller).

HYDRIOMENE GRETTARIA, new species.

Forewing rather pointed at apex, dark gray, the markings indistinct; lines slender, blackish, coarsely waved, about five traceable, one forming an arc at end of cell distinct, black; ground color alternately lighter and darker between the lines, the broadest light areas at base and through middle of wing. Hind wings light gray, uniform. Expanse, 26 mm.

Type.—Male, No. 14677, U.S.N.M., Zacualpan, Mexico, December, 1911 (R. Müller).

Genus CATOCLOTHIS Hulst.

CATOCLOTHIS GYMNOPOMPARIA, new species.

Fore wing with the costal half dark gray, crossed by four broad bands of paler gray of equal width with the dark portions; ordinary lines lost; rather numerous short black streaks centrally, the median vein narrowly lined with black scales; the light bands are sometimes rufous tinted, the rufous in the cell occasionally crossing the middle band and forming a long rufous area; inner half of wing and all of hind wing smooth silky light gray without markings. There is a little black scaling along inner margin of fore wings. Body parts dark gray. Expanse, 35 mm.

Cotypes.—Five males, four females, No. 14518, U.S.N.M., Popocatepetl Park, Mexico, 8,000 feet, June, 1906 (W. Schaus).

Genus CAMBOGIA Guenée.

CAMBOGIA AGROICA, new species.

Ground color light greenish yellow, marked with purplish rose-colored bands; a broad stripe along costa, salmon tinted on costal edge, widened to outer band, then abruptly narrowed; inner band curved, the edges dark purplish; outer band similar, its outer edge crenulate; submarginal band narrower and more uniform; a short slender line across apex. Hind wing with a band close to base; a wide median space of the ground color; outer and submarginal bands joined at costa, then narrowly separated, each broad and with darker purplish edges. Outer margin angled in the middle. Expanse, 20 mm.

Digitized by Google

Type.—Male, No. 14678, U.S.N.M., Orizaba, Mexico, November, 1911 (R. Müller).

CAMBOGIA OPERBULA, new species.

Fore wing overspread with purple, the costa irregularly light salmon color, with a rounded area of this color inclosing the discal dot; termen yellow, the purple color produced in the middle; lines darker, faint, narrow and crenulate, an outer and subterminal visible. Hind wing purple on basal third; outer part yellow, with outer and submarginal faint crenulate reddish lines, which join to form a blotch near inner margin; also traces of a mesial line in some specimens. Expanse, 20 mm.

Cotypes.—Four specimens, No. 14679, U.S.N.M., Orizaba, Mexico, September, 1911 (R. Müller); Orizaba, Mexico (Schaus collection); Jalapa, Mexico (Schaus collection), and one without locality (Schaus collection).

The specimen from Jalapa is one of the types of *Eois nundina* Druce,[1] but the Costa Rican and Guatemalan specimens are of another species, to which I would restrict Druce's name.

CAMBOGIA SARIA, new species.

Roseate purple; fore wing with the margin yellow, incised in the middle, the purple basal area crossed by five more yellowish bands, all finely waved; discal dot small, black. Hind wing similar, the yellow margin less distinctly incised by purple in the middle, the purple field with less lines, being a subbasal dark one and two outer orange-red ones. Vertex and shaft of antennæ white. Expanse, 18 mm.

Type.—One female, No. 14303, U.S.N.M., Orizaba, Mexico, November, 1910 (R. Müller).

Genus TEPHROCLYSTIA Hübner.

TEPHROCLYSTIA GLAUCOTINCTA, new species.

Dark gray, the wings with a mossy green tint over the inner half of fore wing and all of hind wing; fore wing with a small dark sharply limited basal area; lines numerous, indistinct, but marked in their inceptions on costa, about eight lines thus shown, the subterminal most distinctly crossing the wing and narrowly limited outwardly by whitish; discal mark round, dark; narrow black terminal line, dentate on the veins. Hind wing with the base dull whitish; two faint dark lines across before the discal dot; three beyond, the outer submacular and followed narrowly by whitish in the dark glaucous margin. Expanse, 20 mm.

Type.—One female, No. 14450, U.S.N.M., Orizaba, Mexico, August, 1911 (R. Müller).

[1] Biol. Cent.-Am., Lep. Het., vol. 2, p. 110.

Digitized by Google

TEPHROCLYSTIA MOLLIARIA, new species.

Dark gray, smooth and even, only the black discal dot relieved; a faint whitish spot above tornus; outer line indicated by a black strigose shading; a similar row of subterminal markings. Hind wing whitish, grayer along inner margin; a faint discal dot and segment of mesial band near inner margin. Expanse, 18 mm.

Type.—Female, No. 14451, U.S.N.M., Misantla, Mexico, September, 1911 (R. Müller).

Genus MELEABA Walker.

MELEABA URANIA, new species.

White; fore wing with long transverse black strigæ, some of the basal ones crossing the wing completely; a straight median transverse brown shaded line and another at outer third, the pair converging toward inner margin; terminal strigæ shorter, though in part confluent into long lines. Hind wing with an emargination above middle of outer margin, below which is an orange patch containing two or three black dots; a brown line from middle of costa runs outward nearly to the orange patch, then bends roundedly at right angles to inner margin; brown mesial streaks to the transverse line; a number of long black strigæ on apical area; a fine terminal black line. Expanse, 21 mm.

Cotypes.—Male and female, No. 14680, U.S.N.M., Popocatepetl Park, Mexico, 9,500 to 11,500 feet, June, 1906 (W. Schaus).

MELABA ANTITHETES, new species.

Forewing densely irrorated with brown over an ocherous ground, leaving two broad white lines and a discal dot; inner line oblique from inner fourth of costa to middle of inner margin, slightly swollen centrally and excurved below; outer line from outer fourth of costa to tornus, its lower half slightly arcuated inward; discal dot small, narrow; a pale shading runs from apex downward to about middle of wing subterminally, beyond which the brown shadings are darker. Hind wing with an emargination above middle of outer margin, below which is an orange patch containing two black dots; general surface white, but with a dark shading from the brown strigæ below showing through; a faint brown mesial line, bent at right angles; a shaded brown terminal line; a diffuse subterminal one, running inside of the orange patch. Expanse, 21 mm.

Cotypes.—Male and female, No. 14681, U.S.N.M., Popocatepetl Park, Mexico, 9,500 to 11,500 feet, June, 1906 (W. Schaus).

Digitized by Google

Genus TACHYPHYLE Butler.

TACHYPHYLE AGANAPLA, new species.

Rather dark green; vertex of head white; on forewing a straight white line from costa before apex to outer third of inner margin; a black point at apex and a discal point. Hind wing with the white line a little broader, mesial, straight, with a faint darker inward edging; a black discal point. Expanse, 30 mm.

Type.—One female, No. 14455, U.S.N.M., Misantla, Mexico, September, 1911 (R. Müller).

Genus ANISODES Guenée.

ANISODES POLIOTARIA, new species.

Light gray, finely dark-irrorate on a pale gray ground; lines slender, blackish, denticulate; inner line angled subcostally; discal dot white, small; mesial line finely denticulate, oblique; outer line dotted at the ends of the denticulations, not as strong as the mesial line; terminal line slender, broken by white dots between the veins. Hind wing similar, the inner line absent; discal dot in a black ringlet. Expanse, 28 mm.

Cotypes.—8 specimens, No. 14519, U.S.N.M., Tehuacan, Mexico, June, 1910; June, August, September, 1911 (R. Müller).

Genus CÆNOCHARIS Hulst.

CÆNOCHARIS OUDEN, new species.

Smooth powdery gray, shining silky, almost unmarked; inner line slender, dark, faint, angled subcostally; outer line denticulate, followed by a whitish shade in the cusps. Hind wing similarly colored, scarcely lighter; a few dark scales above tornus. Expanse, 21 mm.

Cotypes.—Males, No. 14520, U.S.N.M., Tehuacan, Mexico, September, 1911 (R. Müller); Sierra de Guerrero, Mexico, October, 1911 (R. Müller).

Genus SCIAGRAPHIA Hulst (TEPHRINA Guenée).

SCIAGRAPHIA DECEPTRIX, new species.

Whitish gray, sparsely irrorate; terminal field washed with purplish and cut by a finely wavy white subterminal line; basal area with a little purplish tint; inner line slender, broken, powdery, black, marked on the costa; mesial line marked by a perpendicular brown-black dash on costa, faintly traceable across the wing, with a strong inflexure across submedian; outer line angled subcostally, gently curved below, black, marked on costa, fine and geminate below the bend, followed by a black longitudinal dash at vein 4, with brown

Digitized by Google

below it; a slender terminal black line. Hind wing with brownish tint, finely irrorated; an inner and an outer mesial slender brown line, with small discal dot between them; a series of submarginal cloudings, largest toward apex. Expanse, 20 mm.

Type.—One male, No. 14456, U.S.N.M., Tehuacan, Mexico, August, 1911 (R. Müller).

Genus SEMIOTHISA Hübner.

SEMIOTHISA PHANEROPHLEPS, new species.

Whitish gray, irrorate with brown, the irrorations tending to gather in groups; margins of the wings irregularly shaded with purple-gray; on fore wing cut by a line of the ground color from apex and a patch on middle of outer margin; on hind wing the purplish is restricted to the area above the marginal projection; fore wing with subbasal and inner lines, slender, brown-black, curved; mesial line similar, widened and shaded below, with projections at veins 1 and 2; an obliquely placed discal ringlet filled with yellowish; discal venules lined with yellowish; outer line starting in the costal shade, excurved, then gently incurved, very indistinct except between veins 2–5, where it forms two velvety brown cusps; a small velvety brown spot between veins 2–3, a large one between 3–4 and a small one above vein 4. On the hind wing a line close to base; a straight inner mesial line; discal ringlet nearly occluded; outer line coarsely waved, distinct, followed by velvety brown patches as on the fore wing. Expanse, 25 mm.

Type.—One male, No. 14457, U.S.N.M., Misantla, Mexico, August, 1911 (R. Müller).

Also a male and female from Jalapa, Mexico (Schaus collection), obviously the same but rubbed. The female lacks the velvety patches beyond the outer line, which is more distinct; the marginal purplish shade is irrorated with yellowish.

Genus PHYSOSTEGANIA Warren.

PHYSOSTEGANIA MELANORRHŒA, new species.

Creamy white; fore wing powdered with brown, the lines in the same brown powdering, defined by bands of the ground color on their outer sides; inner curved; median and outer straight, oblique; subterminal straight and erect; three brown costal marks at the inceptions of the three lines. Hind wing with some brown powdering, especially along inner margin, indistinctly defining mesial, outer and subterminal lines on inner half of wing. Male with the anal segment deep black. Expanse, 22 mm.

Cotypes.—Male and female, No. 14682, U.S.N.M., Zacualpan, Mexico, June, 1910, and August, 1909 (R. Müller).

Digitized by Google

Two other males have the genitalia contracted and no trace appears of the black anal tuft, except by dissection. Male and female, Popocatepetl Park, Mexico, 8,000 feet, June, 1906 (W. Schaus); Iguala, Guerrero, Mexico, June, 1906 (W. Schaus).

Genus DEILINIA Hübner.

DEILINIA GRACIOSA, new species.

White, the wings sparsely irrorated with pale gray; the irrorations are arranged irregularly in transverse lines and are partly confluent; an irregular clear space of the ground color represents the inner line; a more distinct one the outer line, its inner edge indicated by a straight line of confluent irrorations; an indistinct space for subterminal line. Hind wing similarly marked. Expanse, 30 mm.

Cotypes.—Two males, one female, No. 14683, U.S.N.M., Popocatepetl Park, Mexico, 8,000 feet, June, 1906 (W. Schaus); Zacualpan, Mexico, June, 1910 (R. Müller).

Genus DIGONODES Warren.

DIGONODES MAIDIENA, new species.

Wings with the outer margin crenulate, the fore wing projecting at the ends of veins 4 and 6. Wood-brown, the color only appearing distinctly at anal angle, all the rest overlaid with blackish, minutely powdery and irrorate; lines gently curved, crenulate, black, single, the outer marked with white points on the veins; discal dot a white point in a black ring; a straight light shade from apex to tornus, nearly touching the outer line centrally. Hind wing similar to fore wing, darkly shaded, lighter at base and margin; an outer mesial black crenulate line; a light space at tornus, sharply limited within. Expanse, 36 mm.

Type.—One female, No. 14458, U.S.N.M., Tehuacan, Mexico, August, 1911 (R. Müller).

Genus SELENIA Hübner.

SELENIA ISMALIDA, new species.

Fore wing gray, mottled-strigose with olivaceous, the median space filled with olivaceous on its lower two-thirds; three costal streaks, at the inceptions of the lines; inner and mesial lines olive-brown, lost below in the shading, the inner line traceable by its pale border; outer line dark, with a light border, strongly angled subcostally, shallowly emarginate between veins 2 and 4; a costo-subapical quadrate olive-brown patch. Hind wing with the discal area faintly yellowish, mottled, with faint discal dot; a curved outer line, relieved by yellowish beyond, the margin broadly darker gray. Expanse, 25 mm.

Digitized by Google

Type.—Male, No. 14521, U.S.N.M., Zacualpan, Mexico, October, 1910 (R. Müller).

A female, which I think belongs to this species, is brown-gray, without the dark shading in median space; inner and median lines brown, distinct, both strongly angled in the middle; marginal space shaded with purplish. Hind wing with the disk more strongly yellow, the purplish freckles distinct; outer line brown-gray, the margin and an area along inner margin brown. Expanse, 30 mm.

Zacualpan, Mexico, October, 1911 (R. Müller).

SELENIA RICOCHETTA, new species.

Brown, the males with a purplish tint, the females red-brown; wings irrorate with darker brown; lines brown, the inner coarsely crenulate and excurved in cell; outer sharply angled subcostally and a little irregular below; mesial line lighter brown and less distinct than the others, sharply angled beyond the cell, running very close to the outer line after the angulation; discal mark narrow, faint, somewhat leaden-tinted. Hind wing with the outer line distinct, preceded by a brown shade that represents the mesial line; purplish clouding subterminally more distinct than on fore wing, representing a pale submarginal line. Expanse, 32–37 mm.

Cotypes.—Three males and three females, selected from a series, No. 14684, U.S.N.M., Jalapa and Coatepec, Mexico (Schaus collection); Orizaba, Mexico, September 2 and June, 1908 (R. Müller).

Genus HYGROCHROMA Herrich-Schäffer.

HYGROCHROMA HYALOPUNCTA, new species.

Male purplish brown, female reddish brown, the wings of the male scarcely falcate at apex, those of the female strongly so with depressed costa. Fore wing with inner line slender, dark, wavy, produced in the cell; median shade distinct, dark, crossing both wings; discal mark narrow or punctiform, hyaline on both wings; a costo-subapical creamy white patch, more drawn out in the female than in the male; outer line slender, dark, faint; a dark shade upward from tornus. Both wings strigose in darker shade, the hind wing with terminal dark shade on lower half. Expanse, 42–47 mm.

Cotypes.—One male, two females, No. 15230, U.S.N.M., Orizaba, Mexico (R. Müller); Jalapa, Mexico (Schaus collection).

The specimens from the Schaus collection were labeled *nondina* Druce, but they differ from that especially in the hyaline discal mark.

Digitized by Google

Genus TEPHRINOPSIS Warren.

TEPHRINOPSIS CONIARIA, new species.

Pale straw color, powdered with brown; fore wing with a large discal dot and four bands of powdery brown; inner one broken centrally; mesial one nearly continuous, but more distinct on costa and inner margin; outer one represented by marks on the costa and margin; subterminal one distinct, broad, preceded by a lighter shade of the ground color. Hind wing with mesial line strongly angled in its middle, its lower limb distinct, its upper limb obsolete; a submarginal pale shade, defined by absence of brown irrorations. Expanse, 21 mm.

Type.—One female, No. 14452, U.S.N.M., Orizaba, Mexico, August, 1911 (R. Müller).

The species looks like *Microxydia pulverosa* Schaus, but it has the lines of the hind wing bent at an angle. It also resembles *Tephrina submarcata* Schaus, but this also has straight bands on the hind wing.

Genus DIASTICTIS Hübner.

DIASTICTIS LAMITARIA, new species.

Light lilacine gray, finely dusted with brown; head and collar dull ocherous shaded; fore wing with the inner line very fine and slender; a small dark discal mark; mesial line just beyond, fine, slender, irregularly waved centrally; outer line similar, straighter, bent outwardly on submedian; subterminal line shaded, with a blotch above vein 5; all the outer lines show dark stains on the costa. Hind wing whitish, freckled with purplish on lower two-thirds; discal dot small; traces of an outer line near inner margin. Expanse, 28 mm.

Type.—One male, No. 14453, U.S.N.M., Cerritos, San Luis Potosi, Mexico, August, 1911 (R. Müller).

Allied to *D. tenebrosata* Hulst.

Genus ANISODES Guenée.

ANISODES MESOTURBATA, new species.

Ground color light ocherous brown, shaded and powdered with dark rusty brown except in the outer half of the median space; inner line dark brown, straight, except for a bend at right angles on subcosta; discal mark a minute light point in a dark ring; mesial line dark, shaded, dentate on the veins, bent inward on submedian; outer line nearly resolved into dots on the veins, bent outward subcostally; veins slightly darker outwardly. Hind wing the same except for the inner line; mesial shade just beyond the discal mark; space between it and the outer line pale. Expanse, 28 mm.

Type.—One male, No. 14454, U.S.N.M., Cerritos, San Luis Potosi, Mexico, August, 1911 (R. Müller).

Digitized by Google

Genus PHIGALIA Duponchel.

PHIGALIA CRYPTAPHELES, new species.

Fore wing light gray; inner line double, blackish, curved; mesial line black, distinct and closely followed by a broad parallel grayer, more powdery band; outer line black, broadly broken centrally except for dots on the veins, indistinctly bordered with vinous without; submarginal line whitish, dentate, obscure; apex lightly blackish clouded. Hind wing white, contrasting; some black specks on inner margin; a slender crenulate terminal black line. Expanse, 28 mm.

Cotypes.—Two males, No. 14548, U.S.N.M., Zacualpan, Mexico, October, 1911 (R. Müller).

Genus CŒNOCALPE Hübner.

CŒNOCALPE SISTENATA, new species.

Light gray with slight carneous tint, sparsely irrorate with black, thinly scaled; a dusky outer band on fore wing, roundedly bent mesially and followed by a whitish shade, obsolete below; a dark mark on the middle of costa. Hind wing without markings. Beneath on fore wing the dark band is repeated in dark scales, the apex is washed with purplish, and a longitudinal streak crosses the purplish field. Hind wing purplish with a dark outer band, running along costa, produced in middle of wing and notched opposite cell; blackish irrorations indistinctly forming a streak directed toward apex. Expense, 26 mm.

Type.—Male, No. 14685, U.S.N.M., Zacualpan, Mexico, December, 1911 (R. Müller).

Near *C. morrisata* Hulst, but smaller with the dark markings more distinct.

Genus APICIA Guenée.

APICIA ENTYCHON, new species.

Pale whitish ocherous, more or less shaded with purplish, densely irrorate with purple strigæ; veins narrowly indicated in brown; lines purple-brown, the inner strongly angled on median vein, the outer angled subcostally, its point directed toward apex; a marginal dark line and discal dot; traces of a mesial line on costal area. Hind wing with the veins dark-lined, a straight band across the middle and terminal line; discal dot small and faint. Expanse, 30–33 mm.

Cotypes.—Two females, No. 14686, U.S.N.M., Zacualpan, Mexico, October, 1911 (R. Müller); Cuernavaca, Mexico, June, 1906 (W. Schaus).

Digitized by Google

Genus STENACIDALIA Packard.

STENACIDALIA UNIDENTIFERA, new species.

Gray, finely irrorate, with brownish shadings; basal space coarsely powdered with black scales; inner line black, strongly curved, a little irregular; median space shaded with brown, irrorated with black squamæ; with a brown-black mesial line that starts on costa before middle, forms a loop beyond discal mark and returns obliquely to inner margin at basal third; discal mark small, white, with black bordering scales; outer line black, slightly wavy above, touching the submarginal line in a sharp point, then oblique and coarsely waved to inner margin before middle, forming a larger undulation below with its point on vein 1; submarginal line brown, shaded, even and parallel to outer margin; some brown shading about apex; a terminal broken black line. Hind wing similarly colored, shaded with brown at base; discal dot as on fore wing but fainter; mesial line brown, curved; extra-mesial line black, wavy, with a sharp point near the middle to the submarginal line, white is brown and parallel to the margin; fringe as on fore wing, more strongly crenulate. Expanse, 35 mm.

Cotypes.—Two males, No. 14549, U.S.N.M., Tehuacan, Mexico, May, 1911 (R. Müller); Cuernavaca, Mexico, May, 1911 (R. Müller).

Genus TEPHROSIA Boisduval.

TEPHROSIA SUPPLANARIA, new species.

Light yellowish gray with a greenish tint; base and cell coarsely powdered with black, in which the inner line is faintly shown, bent subcostally; median line shown as a short black zigzag on costa; discal mark distinct, black, lunate, solid; outer line not far beyond center of wing, black, wavy, broken across the discal venules; a broad shade following it runs down opposite cell and spreads below a little; submarginal line of the ground, edged with black shadings on both sides, wavy-crenulate, a little produced at its upper third, where the following black shade is distinct and touches the margin; a row of marginal black dots. Hind wing pale gray, irrorate with darker gray; a small black discal dot; faint mesial line, most distinct on inner margin; submarginal line rather more distinct, a broken black terminal line. Expanse, 36 mm.

Type.—Female, No. 14550, U.S.N.M., Misantla, Mexico, October, 1911 (R. Müller).

Digitized by Google

Family MEGALOPYGIDÆ.

Genus MESOSCIA Hübner.

MESOSCIA DUMILLA, new species.

Collar and posterior part of thorax white, disk gray; abdomen brownish, with a large gray anal tuft in the female. Fore wing white, crossed by a broad median brown-gray band, which is cut by white veins; the band starts near apex and runs obliquely almost to base, leaving the costa white above the cell and the base of wing white; the band becomes broad on the inner margin and is excised outwardly; a terminal gray band, running from tornus to about vein 5. Hind wing white on the disk, the costa and margins gray. Expanse, 22–30 mm.

Type.—Male, No. 14304, U.S.N.M., Misantla, Mexico, May, 1910 (R. Müller); Paso San Juan, State of Vera Cruz, Mexico (Schaus collection).

MESOSCIA EUTECTA, new species.

Thorax white, collar and pectus black; legs dark gray; thorax tipped with dark gray; abdomen gray above. Fore wing white; a broad dark gray costal stripe, reaching to the cell and stem of veins 7–9; other veins lined with the same color, especially the branches of the median vein; a shade filling in between vein 1*c* and median below the cell; a shade between vein 1 and inner margin except at extreme base. Hind wing white. Expanse, 29 mm.

Type.—Male, No. 14464, U.S.N.M., Orizaba, Mexico, September, 1911 (R. Müller).

Family ZYGÆNIDÆ.

Genus GINGLA Walker.

GINGLA RACONICA, new species.

Wings semitranslucent, dull black; body black, an orange shading over the patagia and anterior half of thorax. Expanse, 19.5 mm.

Type.—One female, No. 14467, U.S.N.M., Cerritos, San Luis Potosi, Mexico, August, 1911 (R. Müller).

Similar to *G. thyesta* Druce, but the wing-shape and venation are different. In this species the veins of fore wing are all separate; in *thyesta* 8 and 9 are stalked.

Family LACOSOMIDÆ.

Genus LACOSOMA Grote.

LACOSOMA MEDALLA, new species.

Wings pinkish brown, a little grayer on the outer margin of fore wing; an extra-mesial curved brown line, common to both wings; fore wing with a faint, gray, elongate discal mark; outer margin

Digitized by Google

scalloped between the veins, and roundedly produced, between veins 2 and 4; fringe narrowly white. Expanse, 35 mm.

Type.—Female, No. 15231, U.S.N.M., Cuernavaca, Mexico, June, 1906 (W. Schaus).

Allied to *Cicinnus lygia* Schaus.

LACOSOMA JULIETTA, new species.

Fore wing pinkish brown over the disk, shading to red in the cell, the margins broadly gray; lines obsolete; discal mark elliptical, blackish, surrounded by gray; outer margin smooth, produced between veins 2 and 4, the apex sharp. Hind wing gray, irrorated with a few coarse dark specks, the discal mark smaller than on fore wing, but similar. Expanse, 27 mm.

Type.—Male, No. 15232, U.S.N.M., Misantla, Mexico, July, 1912 (R. Müller). Closely allied to *L. otalla* Schaus and *L. rosea* Dognin.

Family THYRIDIDÆ.

Genus MESKEA Grote.

MESKEA HORROR, new species.

Fore wing fawn color, shaded with blackish in the cell and with gray terminally; several series of small blackish dots subcostally and in the cell, becoming dense and bordering the veins terminally. Hind wing with a white submarginal band, bent toward the base above tornus, the basal area shaded with black, the termen gray, with dark dots. Expanse, male 30 mm.; female 43 mm.

Type.—One male, No. 13370, U.S.N.M., Jalapa, Mexico, May, 1908 (R. Müller); one male, Cordoba, Mexico (W. Schaus); three females, Cuernavaca, Mexico, June and July, 1906 (W. Schaus).

Similar to *M. dyspteraria* Grote, but the hind wing drawn out with a sharp point, the outer margin distinctly emarginate.

MESKEA SUBAPICULA, new species.

Cinereous yellowish, coarsely irrorate with gray, the irrorations indistinctly arranged in curved transverse bands on outer part of wing; a broad longitudinal black streak below the outer part of the cell. Hind wing with long apical point, strigose and shaded with gray, forming broad bands through the middle and along outer margin. Abdomen blackish gray. Expanse, 19–21 mm.

Cotypes.—Two specimens, No. 14687, U.S.N.M., Oaxaca, Mexico, August, 1911 (W. D. Hunter), labeled as "injuring cotton."

Genus DYSODIA Clemens.

DYSODIA MONAVA, new species.

Olivaceous gray, the bases of both wings infiltrated with straw yellow, covered with dark dense striæ; fore wing with small trian-

Digitized by Google

gular white spot in cell, beyond which a dark band, broad on costa; a narrow submarginal line, partly attached to the small reticulations; termen narrowly dark. Hind wing with the spot in the cell large with an indentation outwardly, all the area beyond it to the termen dark; submarginal line indistinct and broken. Body parts yellowish, olivaceous gray. Expanse, 23 mm.

Type.—One male, No. 14305, U.S.N.M., Zacualpan, Mexico, June, 1910 (R. Müller).

Family PYRALIDÆ.

Subfamily PYRAUSTINÆ.

Genus PHLYCTÆNODES Guenée.

PHLYCTÆNODES CUPREICOSTALIS, new species.

Lustrous yellowish, the wings semitranslucent; collar and costa cupreous brown; lines slender, brown-gray; inner line even, gently curved; orbicular and reniform gray-brown, solid; outer line gently outcurved, then running inward on vein 2 to a point below origin of vein 3, then straight to inner margin; termen narrowly cupreous brown; fringe gray-brown. Hind wing with a single mesial line, similar to the outer line of fore wing, more sharply angled on its bend on vein 3, the reentrant part obsolete; fringe as on fore wing. Expanse, 27 mm.

Cotypes.—Male and female, No. 14449, U.S.N.M., Guadalajara, Mexico (Schaus collection); Sierra de Guerrero, Mexico, August, 1911 (R. Müller).

Genus NOMOPHILA Hübner.

NOMOPHILA IRREGULALIS, new species.

Fore wing powdery gray, with a somewhat carneous underground, darker shaded along the costa; inner line slender, blackish, irregularly dentate; orbicular a dot; reniform a black crescent; outer line strongly excurved over cell and bent on vein 1, irregularly dentate, the points a little pronounced with a slight tendency to form dots; a terminal slender black line. Hind wing silky, whitish, with faint carneous tint. Expanse, 27 mm.

Cotypes.—Male and female, No. 14497, U.S.N.M., Tehuacan, Mexico, September, 1911 (R. Müller).

Genus PYRAUSTA Schrank.

PYRAUSTA MINIMISTRICTA, new species.

Fore wing dark gray, slightly or completely washed with crimson; an outer broad pale gray band, oblique, a little inflexed below; a faint light ray outwardly from base. Hind wing dark fuscous, a little lighter toward base. Expanse, 14 mm.

Digitized by Google

Cotypes.—Three specimens, No. 14448, U.S.N.M., selected from a series, Tehuacan, Mexico, October, 1910, September, 1911 (R. Müller).

PYRAUSTA XANTHOCRYPTA, new species.

Vertex and upper aspect of palpi dull ocherous partly hidden by gray; fore wing dark gray, the lines faintly relieved, dark, with whitish edges; inner slightly curved, its inner whitish border faint; a dark dot in the cell and one at the end, a whitish streak between them; outer line straight, then strongly incurved on its lower third, upward a little, then straight to inner margin, its outer whitish edging distinct. Hind wing fuscous with more or less distinct outer flexuous dark line. Expanse, 17–18 mm.

Cotypes.—Four specimens, No. 14692, U.S.N.M., Mexico City, Mexico, July, 1909 (R. Müller); San Diego, California, May 7 and 20, June 22, 1911 (G. H. Field).

One of the cotypes is in Mr. Field's collection.

Genus CROCIDOLOMIA Zeller.

CROCIDOLOMIA PALINDIALIS Guenée.

Spilodes palindialis GUENÉE, Spec. Gen., Lep., vol. 8, 1854, p. 380.
Botys pyrenealis WALKER, Cat. Brit. Mus., pt. 18, 1859, p. 580.
Botys medonalis WALKER, Cat. Brit. Mus., pt. 18, 1859, p. 599.
Crocidolomia palindialis HAMPSON, Proc. Zool. Soc. Lond., 1898, p. 758.
Evergestis dyaralis FERNALD, Journ. N. Y. Ent. Soc., vol. 9, 1901, p. 49.
Evergestis dyaralis DYAR, Proc. Ent. Soc. Wash., vol. 4, 1901, p. 460.
Evergestis dyaralis FERNALD, Bull. 52, U. S. Nat. Mus., 1903, p. 380, No. 4383.

This species is of wide tropical distribution. I have several specimens before me from Mexico, and have collected it in southern Florida.

CROCIDOLOMIA OCHRITACTA, new species.

Fore wing shining olive brown; inner line fine, blackish, obsolescent, angled in the middle, forming a blotch on inner margin; discal margin lunate, outlined finely in blackish, indistinct; outer line punctiform, angled subcostally, followed by a faint lighter shade; a terminal row of black dashes, emphasized at apex and tornus, the former outwardly oblique minutely, the latter with a light spot in the otherwise dark fringe. Hind wing brownish semitranslucent; a broad even outer black band; fringe dark ocher, except at apex and tornus where it is black. Expanse, 27 mm.

Type.—Male, No. 15233, U.S.N.M., Orizaba, Mexico, June, 1912 (R. Müller).

Genus POLYGRAMMODES Guenée.

POLYGRAMMODES BÆUSCALIS, new species.

Light brown with a reddish tinge, the margins grayish shaded; fore wing with the inner line grayish black, oblique to submedian, then

Digitized by Google

curved; cell hyaline, with blackish central spot and double bar at the end; outer line gray, crenulate, central segment dislocated outward between veins 3 and 5; a subterminal wavy shade. Hind wing with the cell hyaline, a small central black dot and outward reniform mark like the fore wing but with some hyaline area beyond it; outer line and margin as on fore wing. Expanse, 47 mm.

Type.—Male, No. 15234, U.S.N.M., Misantla, Mexico, June, 1912, (R. Müller).

Apparently allied to *P. rufinalis* Hampson from Venezuela.[1]

EDIA, new genus.

Palpi porrect, rostriform, the third joint downward curved and hidden in hair, extending about the length of the head in front. Fore wing trigonate, veins 2 to 5 well separated, the lower part of cell rounded; veins 6, 7 well separated, well below the apex of the cell; 8, 9 stalked, 10 close to the base of the stalk, 11 far removed from apex of cell. Hind wing with the cell produced on its lower half, veins 2 to 5 well separated, 6, 7 stalked from the upper angle of cell, 7 broadly anastomosing with 8 beyond its separation from 6.

Allied to *Protrigonia* Hampson.[2]

Type-species.—*Edia microstagma*, new species.

EDIA MICROSTAGMA, new species.

Fore wing light gray; a black speck at base of costa; inner line curved, black, broad, distinct, shaded outwardly, an inward notch below median vein, an oblique dash slightly within on inner margin, running out on a long oblique scale-tooth; a minute whitish spot in cell, surrounded by black; a brown shading beyond, diffused outwardly; apex broadly brown shaded, in which are black streaks on the veins with shorter white ones above and in the fringe. Hind wing fuscous with a faint outer curved dark line followed by whitish blotches toward tornus. Expanse, 19–20 mm.

Cotypes.—One male, one female, No. 15235, U.S.N.M., Tehuacan, Mexico, June, 1912 (R. Müller); Huachuca Mountains, Arizona, July 24–30 (Dr. W. Barnes). The Arizonan specimen is larger and lighter than the Mexican one, the brown shade on middle of fore wing is less extensive and the fringes of hind wing are white. A second specimen from Arizona has been in the hands of Prof. C. H. Fernald for many years (labeled 108) and will ultimately rest in Doctor Barnes' collection.

Subfamily CRAMBINÆ.

Genus DORATOPERAS Hampson.

DORATOPERAS SYSTRAPEGUS, new species.

Body and fore wing light creamy yellow, the fore wing sparsely irrorated with black; a rather large black discal mark; lines brown,

[1] Proc. Zool. Soc. Lond., 1898, p. 198.

[2] Moths of India, vol. 4, 1896, p. 414.

Digitized by Google

faint; first line beyond the middle, very irregular, strongly excurved over cell and dentate on the veins; outer line submarginal, strongly dentate on the veins; a row of terminal black dots. Hind wing whitish with terminal dusky black dashes. Expanse, 53 mm.

Cotypes.—Two males, No. 14447, U.S.N.M., Misantla, Mexico, August, 1911 (R. Müller); Omai, British Guiana (W. Schaus).

Subfamily EPIPASCHIINÆ.

Genus TIOGA Hulst.

TIOGA BUNNIOTIS, new species.

Basal area broad, ocherous, shading to dark brown outwardly, finally black just before the white inner line, which is slightly excurved below the middle; a black costal dash at base; rest of the wing light gray; outer line white, finely denticulate, edged within by black narrowly; terminal space shaded with blackish especially apically. Hind wing pale fuscous, shading to blackish along the margin rather darker in the female; a terminal black line; fringe light at base. Expanse, 20–26 mm.

Cotypes.—Three males, one female, No. 14688, U.S.N.M., Orizaba, Mexico, November, 1911 (R. Müller); Orizaba, Mexico (Schaus collection); Jalapa, Mexico (Schaus collection).

PARANATULA, new genus.

Palpi upturned, in the male with a long thick basal process, hairy on its upper side. Fore wing with veins 3, 4, 5 from the angle of the cell, 4, 5 closely approximated for one-fourth their length, 6 from the upper angle of the cell, 7 to 9 stalked, 10 free but close to the stalk of 7–9 at base. Hind wing with vein 3 from the lower point of the cell, 4, 5 stalked for half their length, 6 from the cell, 7 anastomosing with 8.

Type-species.—*Paranatula zographica*, new species.

PARANATULA ZOGRAPHICA, new species.

Fore wing violaceous gray, the basal and terminal areas light pinkish gray; basal area diffused outwardly, a narrow black dash on inner margin at base and one outwardly below center of cell; traces of an irregular black mesial line; outer line black, distinct, curved in a gentle arc from outer third of costa to outer fourth of inner margin, limiting the mesial gray area; faint clouded gray subterminal shade. Hind wing fuscous tinged outwardly, the veins darker, fringe pale. Expanse, 17 mm.

Cotypes.—One male, two females, No. 15236, U.S.N.M., Aroa, Venezuela (Schaus collection); Orizaba, Mexico, June, 1912 (R. Müller); Jalapa, Mexico (Schaus collection).

Digitized by Google

Subfamily PHYCITINÆ.

Genus MELITARA Walker.

MELITARA PARABATES, new species.

Head and thorax dark gray, intermixed with blackish scales; abdomen whitish, the segments gray dorsally. Fore wing light gray, a little shaded with brownish on the inner half; some blackish shading at base; inner line remote from base, black, double, dentate, the outer line the most distinct, with a long tooth in cell and below median vein; a blackish shade-band mesially below cell; discal mark of two joined dots; subcostal veins above the cell black-lined; outer line near the margin, black, strongly dentate, indistinctly doubled outwardly, an inward tooth opposite discal mark, smaller teeth on the discal venules, an inward tooth on vein 1; veins in terminal space dark-lined; a row of terminal black dots. Hind wing white, the apex tipped with gray. Expanse, 39 mm.

Type.—Female, No. 14446, U.S.N.M., Cerritos, San Luis Potosi, Mexico, August, 1911 (R. Müller).

Genus EUZOPHERA Zeller.

EUZOPHERA GRISELDA, new species.

Dark blackish gray, without any reddish tint; lines far out, the inner at the middle of wing, whitish, edged with dark gray toward each other, the inner a little irregular and strongly incurved at submedian, the outer finely subdentate, excurved centrally and inward on submedian; discal mark squarish, white. Hind wing whitish, shaded with fuscous along the veins and in a narrow marginal band. Expanse, 26 mm.

Cotypes.—Two females, No. 14551, U.S.N.M., Tehuacan, Mexico, September, 1911 (R. Müller).

EUZOPHERA IMMORELLA, new species.

Fore wing rather dark gray, powdered with black; inner line black, produced outward into a tooth in the middle, the costal segment forming an oblique thick band; discal mark of two dots conjoined by their inner angles; outer line double, black, oblique, slightly crenulate and with an inward angle opposite the discal mark. Hind wing whitish, semihyaline, tinged with fuscous on veins and margin. Expanse, 25 mm.

Cotypes.—Two females, No. 15237, U.S.N.M., Tehuacan, Mexico, July, 1912 (R. Müller); Oaxaca, Mexico (Schaus collection), the latter labeled "*Euzophera* sp., not in B. M." in the writing of Sir G. F. Hampson.

Digitized by Google

BALLOVIA, new genus.

With the characters of *Pristarthria* Ragonot,[1] but the antennæ of the male have only a single tooth in the basal sinus.

Type-species.—*Ballovia cistipennis*, new species.

BALLOVIA CISTIPENNIS, new species.

Fore wing gray, with more or less of a whitish shade through the middle; a large rounded black spot in the center of the wing in the position of the inner line, outlined by the whitish shading, which in dark specimens forms an annulus about it; discal mark lunate, dark, faint; outer line whitish, curved inward below costa and at submedian fold, a dark gray shade within it in pale specimens, widening below; subterminal line whitish, preceded and followed by gray dots, which are illy contrasted in dark specimens. Hind wing whitish, translucent, a little yellowish tinted on margin; inner margin folded and swollen in the male, covering yellowish androconia. Expanse, 20–21 mm.

Cotypes.—Four males, one female, No. 15238, U.S.N.M., Wildey, Barbados, October 31, 1911 (H. A. Ballou, Commissioner of Agriculture, Imperial Department of Agriculture for the West Indies), larvæ injurious to cowpeas.

Family COSSIDÆ.

Genus GIVIRA Walker.

GIVIRA GABRIEL, new species.

Dark gray. Fore wing pale gray on the central third, brownish gray at base and in a large area over the discal venules; a semilunate deep brown bar, touching the costa subapically, surrounded by white; a similar upright angular marking on middle of inner margin, nearly reaching costa; a slight olivaceous tint in the shading along inner margin; reticulations indistinct, dotted along the costal area, very fine on lower part of wing. Hind wing whitish gray, finely powdery-reticulate. Expanse, 34 mm.

One male, Cerritos, San Luis Potosi, Mexico, August, 1911 (R. Müller).

Type.—No. 14468, U.S.N.M.

GIVIRA FELICOMA, new species.

Reddish brown, the costa and outer area of wing gray, all with dense, short, clouded gray strigæ; a dark cloud at end of cell, followed by brighter reddish; dark also between the discal venules, which are themselves reddish lined. Hind wing whitish, with but few gray strigæ. Expanse, 36 mm.

[1] Monog. Phyc. et Gall., Mém. Lép. Romanoff, vol. 7, 1893, p. 326.

Digitized by Google

Type.—Male, No. 15239, Cuernavaca, Mexico, April, 1912 (R. Müller).

Close to *G. flavescens* Dognin, but more densely strigose, especially on the outer half of wing.

Genus ARBELA Moore.

ARBELA NAIDA, new species.

Fore wing brownish gray, the strigæ small and sparse, forming wavy lines on the outer part of wing; a blackish cloud beyond cell; a slender silvery white line along inner margin to middle; a terminal row of black streaks at the terminations of the veins. Hind wing gray, scarcely strigose, with terminal marks as on fore wing. Expanse, 31 mm. Male antennæ simple.

Type.—Male, No. 15240, U.S.N.M., Cuernavaca, Mexico, April, 1912 (R. Müller).

Digitized by Google

A NEWLY FOUND METEORITE FROM NEAR CULLISON, PRATT COUNTY, KANSAS.[1]

By GEORGE P. MERRILL,
Head Curator of Geology, United States National Museum.

The stone described below was found by Mr. A. J. Oshel, who writes that "it struck the earth December 22, 1902, on the northeast corner of section 25, township 28, range 15, in Pratt County." As it was not found until 1911 we are confronted with the usual doubt as to whether the stone is actually the one seen to fall on the date given. The oxidized condition of its crust leaves no doubt as to its having lain for a considerable time in the ground, but for how long there is no means of estimating. Excepting for the natural feeling of caution that exists in the mind of every man experienced in such matters, there is no apparent reason for not accepting the date given.

The general appearance of the stone is shown in figures 1 and 2 of plate 54. It is a very complete individual, a chip of a few grams weight only having been broken from one edge. There exists no large, recently broken surface to suggest that it became broken after reaching our atmosphere, or that the one stone may not constitute the entire fall.

The crust, which extends practically over the entire surface, is very thin and has suffered to such an extent through oxidation that nothing of value can be learned from its study. Except for an occasional slightly protruding metallic point where it has been rubbed, and for the pittings, the appearance of the stone is so like that of a weathered bowlder of a dense, fine-grained trappean rock that for some time there existed a doubt as to its true nature, a doubt which was, however, immediately dispelled on viewing a thin section through the microscope. On a broken surface the stone is nearly black and without structural features or metallic points recognizable to the unaided eye. Characteristic pittings are present, particularly on the broad end shown at the lower right in the figures of plate 54. Both of the views on this plate, it should be stated, are somewhat diagonal in order to bring into view as much of the surface as possible, and hence fail to show the full size of the stone. The maximum

[1] Catalogue No. 430, U. S. National Museum.

Digitized by Google

dimensions are as follows: 21 cm. by 25 cm. by 12 cm.; weight, 10.10 kilograms.

As mentioned above, the stone is so dense and fine-grained that nothing of its mineral nature can be learned from an examination of a broken surface by the unaided eye. A sawn and polished surface is, however, abundantly specked with small metallic points and numerous chondrules. In the main the distribution of the metallic constituents is fairly even, but diversified by stringers of either metal alone or metal and metallic sulphide together, which seem for the most part to have a general trend; that is, their longer axes show a tendency toward parallelism as though developed along lines of weakness caused by shearing. (Pl. 55, fig. 2.)

In the thin section the meteoric nature of the stone is at once apparent. Everywhere it presents a dense aggregate of small chondrules, sometimes mere fragments or again remarkable for their sharp and circular outline, imbedded in a fragmental and tuff-like ground. In its mineral composition the stone presents nothing new; olivine, orthorhombic and monoclinic pyroxenes and fragmentary plagioclase feldspars, together with metallic iron and iron sulphides, make up the entire recognizable constituents. As noted later (p. 330), there seems a possibility of the one-time presence of oldhamite.

The stone is of interest, however, from the diversity of the chondritic forms which it carries. There are the common monosomatic, barred, grate-like and porphyritic forms composed wholly of olivine; the radiating fan-like forms composed of enstatite; also porphyritic forms composed of enstatite in a smoky or felt-like glass, and still further chondrules composed wholly of twinned, monoclinic pyroxenes. These last sometimes display a structure which is new to me, the outer rim consisting of crystals somewhat curved to conform to the outline of the chondrule and elongated in the direction of their vertical axes, so that sections in other than the orthopinacoid zone show more or less distinct striations. Interiorly this type of chondrule is a mass of imperfectly outlined granules some of which show twin striæ, but the structure as a rule is very obscure and no attempt has been made to reproduce it in detail by photograph or drawing. An occasional form is met with in which the interior is wholly of a yellowish glass while the rim is of a fibrous pyroxenic (?) material radiating from a common center. Several minute and very nearly circular chondrules were noted, like a slightly brownish, wine-tinted homogeneous glass traversed by numerous cracks into which secondary iron oxides had penetrated. Between crossed nicols this glass proves not absolutely isotropic, but a portion remains light, the dark cloud sweeping over it as the stage is revolved, in a manner to suggest a condition of mechanical stress. Occasional faintly bluish-gray forms occur which are apparently comparable with those described by Tschermak in the stone of Tipperary.

Digitized by Google

In slicing this stone the saw passed through the larger diameter of a nodular mass some 10 by 17 mm. of a distinctly lighter, somewhat greenish-white color, which from its sharp boundaries at once excited interest, and steps were taken to secure a thin section without wholly destroying the material. (See pl. 55, figs. 1 and 2.) This section, when placed under the microscope, was found to be composed, with the exception of a few grains of troilite, wholly of the twinned pyroxene noted as occurring sporadically in the body of the meteorite. It is to be noted, however, that the structure is not chondritic, but the entire mass is made up of granular and columnar forms elongated parallel with the vertical axes, all closely interknit, with no residual glass, forming the *hypidiomorphic granular* structure of Rosenbusch. Though an abundant constituent of the surrounding mass, no metallic iron could be detected in the body of the nodule. The dark points shown in the photograph are of iron sulphide.

Incidental to this inclosure attention should be called to another structural feature of even greater import. This is a somewhat indistinct wavy banding visible only on a polished surface. Close inspection shows this to be due to elongated, illy defined areas of a dark greenish color with intervening wavy, narrower bands, sometimes mere lines, of a darker hue. The wider greenish bands are thickly studded with rounded spots caused by chondrules, which are much less abundant in the dark bands. The metallic particles, both sulphide and native iron, seem to be disseminated through all portions alike. The effect is of a nature that might be produced by a shearing force exerted on a body already solidified but still capable of yielding; in other words, it corresponds apparently with the *schlieren* structure of terrestrial rocks. That this structure is actual is further shown by the tendency of the larger metallic sulphides to be elongated in this same general direction. It is further to be noted that minute rifts which have opened in the stone since its fall, and are obviously due to exposure, all tend in the same general direction. Indeed it seems probable that the shape of the mass as found is due to a natural tendency to exfoliation along these lines, the maximum dimensions given on page 326 being those parallel with the schlieren lines mentioned.

This structure is brought out somewhat obscurely in figure 2 of plate 55 from a photograph of a polished slice, and reproduced about two-thirds of the actual size. In the upper left is shown the pyroxene inclosure already described. An irregular band some 10 mm. in width is conspicuous, extending entirely across the surface from left to right just below this inclosure, and shorter areas again below this. An attempt was made to bring out this structure still more clearly in figure 1 of this plate from a photographic enlargement of about five diameters. The inclosure is here seen imbedded in a darker

Digitized by Google

ground displaying structures which to my mind can be explained only on the supposition that it was imbedded in a finer ash-like ground which, on being subjected to a shearing movement, had yielded, giving results closely simulating the flow structure produced under similar conditions in terrestrial rocks.

A brecciated structure is not uncommon in meteorites. Indeed, the mineral constituents of stony meteorites are more common in a fragmental condition than otherwise. A true breccia structure produced by rock fragments imbedded in a finer ground, as is the case of the stones of St. Mesmin and Soko Banja, or the Mount Joy iron, is much more rare, and I have not seen, either in the stone itself nor in written descriptions, anything comparable to the structure I have attempted to describe above. If I am right in my interpretation of what is shown, it of course means that this stone was once a portion of a vastly larger mass in which stresses were operative as in the moderately deep-seated portions of the crust of our own earth. The occurence differs from that of Chattonay, as described by Tschermak, in that iron is very uniformly distributed throughout the ground, while only the sulphide is apparent in the inclosure. From the Orvinio stone it differs in that the inclosure is not of the same mineral nature as the matrix, containing no olivine nor metal, but consisting wholly of the pyroxene and iron sulphides.

A word with reference to the iron sulphide. This is distributed very generally throughout the stone both in small particles, as is the metallic portion, and also in larger forms, the section shown in figure 2, plate 55, which is some 15 cm. by 10 cm. in dimension, showing seven sulphide areas varying from 5 to 10 mm. in length besides innumerable smaller forms. These are so closely associated with the metallic particles as to be practically, and in some cases actually, in contact with them. In one instance an area of sulphide about 3 mm. in length and 1 mm. broad is capped, as it were, at either end, with the native metal. (Pl. 55, fig. 3.) In other cases metal and sulphide appear mutually intergrown. The matter is mentioned in detail as having some bearing upon the mineral nature of the sulphide, it being usually conceded that the form found in metallic meteorites is the monosulphide troilite, and in the stony forms, pyrrhotite. Recent work by Dr. E. T. Allen,[1] of the Carnegie Geophysical Laboratory, shows that in the presence of an excess of iron only the monosulphide is possible, and it would hence seem probable that it must so exist in the stone here described. It is possible, however, that there may be a gradual change in the character of the sulphide as the distance from the point of contact increases, the monosulphide (FeS) forming at the immediate contact and this grading into compounds conforming to the formula Fe_nS_n+1. Separation of the material for analysis in order to determine this point is obviously impossible.

[1] Amer. Journ. Sci., vol. 33, 1912, p. 212.

Digitized by Google

Chemical and mechanical analyses of the stone, by Dr. J. E. Whitfield, yielded results as below.[1]

A separation by means of an electromagnet and treatment of the residue with iodine yielded—

	Per cent.
Troilite (?)	6.00
Metallic iron	19.40
Silicate minerals	74.50
Schreibersite	.10
	100.00

The metallic portion yielded—

	Per cent.
Silicon	.129
Sulphur	Trace.
Phosphorus	.071
Nickel	9.207
Cobalt	.507
Copper	.040
Chromium	.160
Carbon	.088
Manganese	.080
Iron	89.700
	99.982

No traces found of molybdenum, tungsten, or vanadium.

The silicate portion yielded—

	Per cent.
Silica	47.36
Alumina	5.67
Ferric oxide	.10
Ferrous oxide	11.25
Lime	.84
Magnesia	31.72
Manganese protoxide	.36
Soda	2.42
Potash	.23
Titanic oxide	.00
	99.95

Combining the metallic and nonmetallic portions and recalculating after making the very unsafe assumptions that the material called troilite is all the monosulphide, and that the schreibersite conforms to the formula Fe_2NiP, the following figures are obtained, representing the composition of the stone in mass or bulk:

	Per cent.
Silica (SiO_2)	35.30
Alumina (Al_2O_3)	4.24
Ferric iron (Fe_2O_3)	.75
Ferrous iron (FeO)	8.38
Lime (CaO)	.62

[1] This analysis is one of several made by Doctor Whitfield for the present writer under a grant from the National Academy of Sciences, to which body he is indebted for the privilege of utilizing the same here.

Digitized by Google

	Per cent.
Magnesia (MgO)	23.631
Manganese oxide (MnO)	.268
Soda (Na_2O)	1.804
Potash (K_2O)	.171
Sulphur (S)	2.184
Phosphorus (P)	.0138
Nickel (Ni)	1.80
Cobalt (Co)	.098
Copper (Cu)	.008
Chromium (Cr)	.029
Carbon (C)	.017
Manganese (Mn)	.015
Iron (Fe)	21.270
Total	100.5988

Specific gravity, 3.65.

None of the rarer elements sometimes reported as occurring in meteorites were found, although very carefully looked for.

Should we refer all the soda and lime to the feldspar it is evident that it belongs to an acid type nearer albite than oligoclase. That all the *lime* can not be so referred is, however, rendered doubtful by the following:

An attempt was made to isolate some of the component minerals by the usual process of crushing, washing, and use of heavy solution. The results were complete failures. In the course of the attempt, however, the water, in which a finely pulverized sample had been standing for some 24 hours, was tested and gave distinct reactions for lime and sulphuric acid. Three independent tests, two by myself and one by Mr. Chester Gilbert, yielded similar results, Mr. Gilbert getting 0.0052 grams of CaO from 9.2495 grams of the pulverized stone after digesting in distilled water for 24 hours. Mr. Andrew A. Blair, at my request, digested a powdered sample for 24 hours in dilute hydrochloric acid, 1 part acid to 50 parts water. The solution yielded 0.28 per cent CaO, 0.05 per cent SO_3, and 1.14 per cent MgO, the last named undoubtedly derived from the olivine.[1] These results led to a very careful search for oldhamite, the rare calcium sulphide. With one possible exception nothing could be found in the slides that could with any degree of certainty be thus referred, and one is forced to conclude that if such existed it has gone over to an earthy or perhaps ocherous gypsum and is no longer recognizable. It will perhaps be remembered that I was driven to a similar conclusion in the case of the Hamblen (Morristown), Tennessee, siderolite, described some years ago.[1] It is of course possible that the minute quantity of lime found may have come from an easily decomposed feldspar.

[1] Amer. Journ. Sci., vol. 2, Aug., 1896, p. 149.

Digitized by Google

1

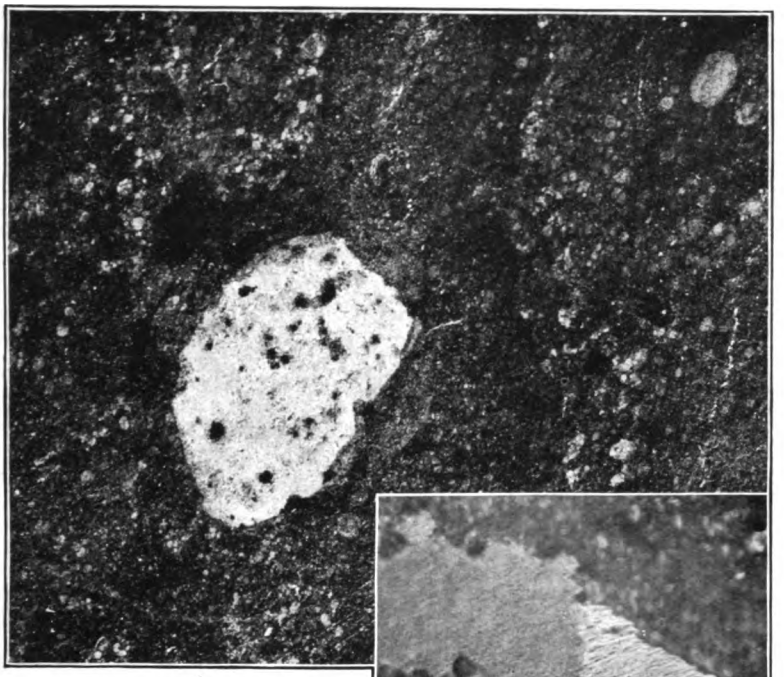
2

THE CULLISON METEORITE, PRATT COUNTY, KANSAS.

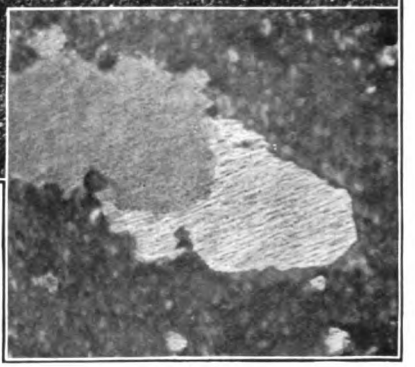
Two views of stone as found.

Digitized by Google

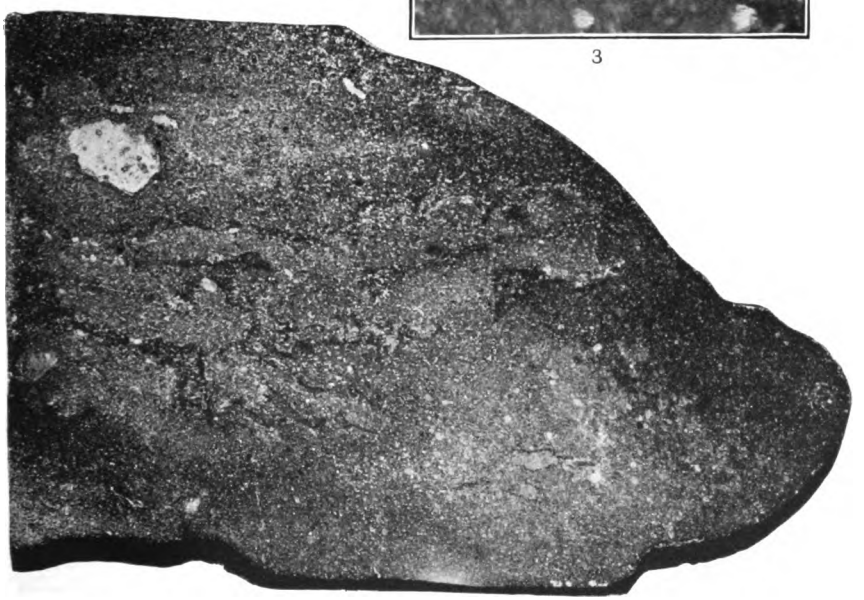
Digitized by Google



1



3



2

THE CULLISON METEORITE, PRATT COUNTY, KANSAS.

Fig. 1.—Polished slice enlarged about 5 diameters. Fig. 2.—Polished slice, about two-thirds natural size. Fig. 3.—Iron sulphide capped at right by metallic iron.

Digitized by Google

Digitized by Google

A REVISION OF THE SOUTH AMERICAN DIPTEROUS INSECTS OF THE FAMILY PTYCHOPTERIDÆ.

By CHARLES P. ALEXANDER,
Of the Entomological Laboratory of Cornell University, Ithaca, New York.

The only genus of Ptychopteridæ as yet made known from the Neotropical regions is *Tanyderus* Philippi,[1] erected in 1865 to receive the then unique species, *pictus* Philippi, of Chile. Two New Zealand species, *forcipatus* Osten Sacken[2] and *annuliferus* Hutton,[3] have been described. The *Cylindrotoma ornatissima*, described by Doleschall from the East Indies in 1858, was later found to be a true *Tanyderus*.[4]

I have given, below, a rather free translation of Philippi's original description of *T. pictus* and also add the description of a fifth species, the second from the American continent.

KEY TO THE AMERICAN SPECIES OF TANYDERUS.

Anal angle of the wing very sharp; wing with two brown fasciæ which are almost unicolorous in all of the cells; antennæ with at least 25 segments.....*pictus*.

Anal angle of the wing less pronounced, square; wing with an irregular picture; dark along the cross-veins, much paler in the posterior cells of the wing; antennæ 17-segmented.....*patagonicus*.

TANYDERUS PICTUS Philippi.

Length body, 12 l.; wing expanse, 26 l.

Head quite black, only the antennæ are pale yellow, except the first two segments, which, however, are black. The long, slender neck-like prothorax is also black and there appears above in the cephalic half a caniculated excavation, which is run through by an elevated longitudinal line continuing to the posterior margin. The anterior portion of the mesothoracic præscutum is yellow with a black spot in the middle; the remainder of the mesothorax is, for the most part, black; on the pleuræ, in front of the wing basis, is a yellow

[1] R. A. Philippi. Aufzählung der Chilenischen Dipteren, Verh. der Zoöl.-bot. Ges., 1865, vol. 15, pp. 780, 781, pl. 29, fig. 57.
[2] Verh. Zoöl.-bot. Ges., 1879, p. 518.
[3] Trans. New Zealand Institute, vol. 32, p. 48.
[4] Osten Sacken, Studies on Tipulidæ, pt. 2, 1887, pp. 228-230.

Digitized by Google

spot, and the space before the scutellum is likewise yellow; remainder of the pleuræ yellow with black spots; metanotum is yellowish with four black spots on the caudal margin. The segments of the abdomen are yellow with black posterior edges and black longitudinal spots, of which there are four on the dorsum in two rows. The wings have yellow veins and a yellowish membrane, especially in the middle, and there are ramifying, yellow, black-bordered crossbands, which make this species one of our most beautiful Tipulids. The legs are yellowish with black coxæ and a blackish ring above and below the knee; they are rather strongly haired. Halteres are black with bright stem.

The species has an extremely sharp anal angle and possesses a supernumerary cross vein in cell R_4 of the wing.

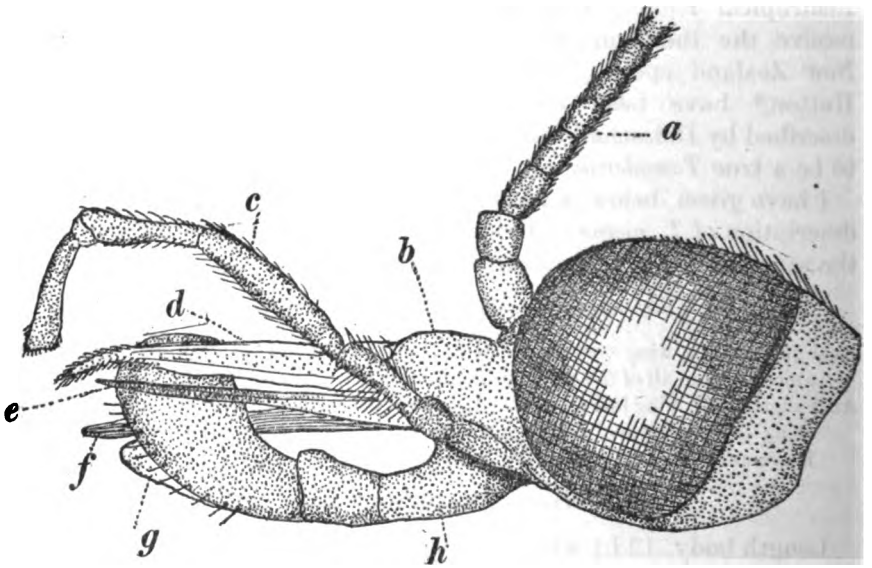


FIG. 1.—LATERAL ASPECT OF THE HEAD OF TANYDERUS PATAGONICUS. *a*, ANTENNA; *b*, CLYPEUS; *c*, MAXILLARY PALPUS; *d*, LABRUM; *e*, MAXILLA; *f*, HYPOPHARYNX (?); *g*, HYPOPHARYNX (?); *h*, LABIUM.

TANYDERUS PATAGONICUS, new species.

Antennæ 17-segmented; thorax gray with chestnut stripes; anal angle of the wings not prominent; supernumerary cross veins in cells R_3 and R_5; wings marked with brown and gray.

Female.—Length, 12.1 mm.; wing, 18.2 mm. Legs, posterior femora, 8.2 mm.; tibia, 9.8 mm.

Head.—Mouth parts, clypeus (*b*) rather quadrate, about as broad as long; the labrum closely applied to its cephalic margin. Labrum (*d*) elongate, depressed, flattened, its edges toward the tip, with numerous stout hairs; underneath the labrum is a pair (*e*) of elon-

Digitized by Google

gate, slender, extremely pointed stylets which I believe to be homologous with the maxillæ of certain other Diptera (Tabanidæ); at the base of the maxillæ, beneath the clypeus, arise the elongated maxillary palpi (*c*), which are almost as long as the antennæ; these palpi are 5-segmented; segment 1 short; 2 twice as long as 1; 3 longer than 1 and 2 combined; 4 and 5 subequal, longer than 2 but shorter than 3; palpi clothed with long appressed hairs; between the labrum and labium, there projects an elongated stylet, almost as broad as the labrum, which seems to be homologous with the hypopharynx (*f*); the possibility exists, however, that it may consist of the two mandibles closely applied to one another. The specimen is unique and I do not care to remove the mouth parts. The elongated labium (*h*) apparently 2-segmented, and bearing a pair of broad palpi at the tip, arises from the ventral surface of the head; viewed from beneath, the labium is seen to consist of a basal and apical piece, the latter deeply divided by a longitudinal furrow; the palpi divergent, their margins clothed with long, stout hairs; from between the palpi there projects outward a narrow compressed organ (*g*); this may (in case the organ (*f*) described above as possibly being the hypopharynx is not this) be the hypopharynx. In this case the mandibles would be present and accounted for in the organ described above as the hypopharynx.

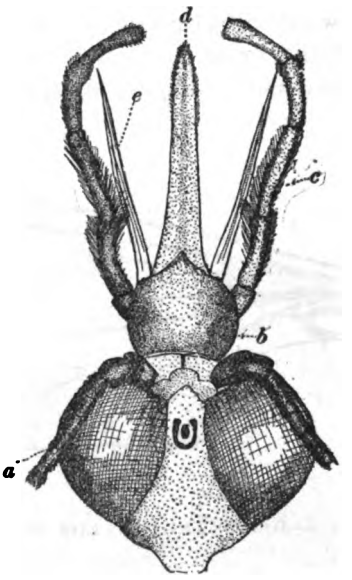


FIG. 2.—DORSAL ASPECT OF THE HEAD OF TANYDERUS PATAGONICUS. *a*, ANTENNA; *b*, CLYPEUS; *c*, MAXILLARY PALPUS; *d*, LABRUM; *e*, MAXILLA.

Occipital region narrowed behind, broadening to the vertex; vertex narrowed between the eyes, its sides parallel; front encroaching onto the inner margin of the eye in a broad, shallow sinus, in which the antennæ (*a*) are located. Antennæ, 17-segmented; the scapal segments almost smooth or with very small hairs; both segments short, the first cylindrical, the second oval, its distal end more enlarged; the flagellar segments clothed with dense appressed hairs; basal flagellar segments almost subequal; apical segments more elongated. (See figs. 1 and 2.)

Mouth-parts yellow, the labium brown; maxillary palpi dark brown; clypeus dull brownish gray; antennæ dark brown, the clothing of hairs on the flagellum rather paler.

Digitized by Google

Front dark brown, black apically and with a narrow median stripe; vertex brown with a black U-shaped mark between the eyes; occiput and genæ brown.

Cervical sclerites prominent, transverse, deep velvety black on the dorsal mid line, grayish brown laterally.

Thorax.—Pronotum, the scutum projects on the dorsal surface of the insect, the scutellum is not visible from above, dark brown, paler on the sides. Mesonotum, præscutum gray, the extreme mid line narrowly black; on either side of this, extending from the cephalic margin of the sclerite backward to the transverse suture where they become confluent, a broad chestnut stripe; laterad of this, near the middle of the sclerite, a broad brownish-chestnut stripe runs backward, interrupted by the shallow, open, transverse suture. Scutum light brown mesially, caused by the spreading out of the central præscutal stripes; on the sides of the sclerite are the well-defined

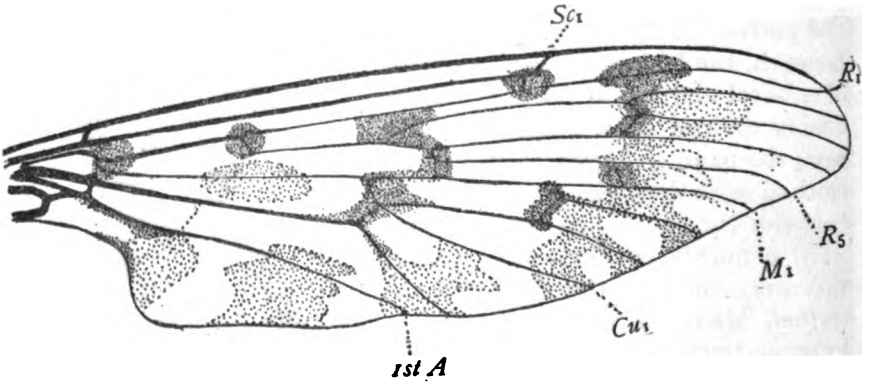


FIG. 3.—WING OF TANYDERUS PATAGONICUS. Sc_1, SUBCOSTA 1; R_1, RADIUS 1; R_5, RADIUS 5; M_1, MEDIA 1; Cu_1, CUBITUS 1; *1st A*, ANAL.

continuations of the brownish-chestnut lateral præscutal stripes; scutellum and post-notum rich brown; metanotum dull brown. Pleuræ, spiracles prominent, spongy in appearance, yellow; epipleuræ gray, sternal region more brown. Halteres brown, stem slightly paler. Legs, coxæ, and trochanters dull gray; femora rich brown; dark brown at the tip; tibia extreme base and tip brown, remainder yellow; tarsi dark brown.

Wings.—Venation, *Sc* long, its tip nearer the fork of R_{3+2} than to the fork of R_{4+5}; a spur at the fork of *Sc*; a slight spur at the origin of R_5; an oblique supernumerary cross vein in cell R_3; a second one in cell R_5. Anal angle of the wing not especially prominent.

Wings (fig. 3) subhyaline, veins brown; cells *C* and *Sc* yellow; wings marked with gray and brown as follows: Brown; a rounded spot at the base of the wing under the cross vein *h*; a second at the origin of R_5; a third under the tip of *Sc*; a large irregular spot extending along the cord which is on the proximal half of the wing; a

Digitized by Google

brown seam on the two supernumerary cross veins and on *m*; stigma oval, lighter brown. The gray extends as an irregular band distad of the supernumerary cross veins; and as an interrupted band proximad of the cord; an isolated spot in the ends of the cells Cu_1 and *Cu*.

Abdomen.—Tergum light yellowish brown; a narrow brown median stripe; caudal edge of the sclerites gray, interrupted medially by the brown median line; lateral edge of the sclerites dark brownish black, narrowest caudally; segment eight dark brown; genital segment light brown. Sternum light yellowish white, a brown transverse sub-basal band; eighth segment dark brown.

I wish to thank Dr. W. A. Riley, of Cornell, for kind assistance with this paper.

Holotype.—Latitude Cove, Patagonia; United States Bureau of Fisheries; accession No. 21999.

Type.—Cat. No. 14919, U.S.N.M.

Digitized by Google

Digitized by Google

TERRESTRIAL ISOPODS COLLECTED IN COSTA RICA BY MR. PICADO, WITH THE DESCRIPTION OF A NEW GENUS AND SPECIES.

By HARRIET RICHARDSON,

Collaborator, Division of Marine Invertebrates, United States National Museum.

Some terrestrial isopods collected in Costa Rica by Mr. C. Picado were sent by Mr. J. F. Tristan to the United States National Museum for determination. They were found on epiphytic plants of the family Bromeliaceæ ("wild pines") and were mostly collected at an altitude of 2,000–2,500 meters. Among them are some specimens representing a new genus of Oniscidæ.

Other terrestrial isopods collected in Costa Rica by Mr. J. F. Tristan were also sent to the United States National Museum about the same time. These were collected in the Bromelias in the old crater of "Reventado" near the Volcano Irazu. Mr. Tristan writes that the old crater is covered with forest.

Family ONISCIDÆ.

PENTONISCUS, new genus.

Body with the abdomen abruptly narrower than the thorax.

Head with median and antero-lateral lobes small.

Second antennæ with a flagellum composed of five articles, the third and fourth rather indistinctly separated.

Mouth parts as in the other genera referred to this family. Inner lamella of the second maxilla furnished with two plumose setæ. Mandibles with molar expansion obsolete, and replaced by a recurved seta; cutting edge formed of three blunt teeth. Maxillipeds with palp composed of three articles, the last very narrow and elongate; masticatory lobe short and truncate at tip.

Terminal segment of abdomen triangular, with apex obtuse.

Uropods of a structure similar to those in the other genera in the family.

The type of the genus is *Pentoniscus pruinosus*, new species.

This genus differs from all the known genera of Oniscidæ in having the flagellum of the second antennæ composed of five articles.

Digitized by Google

PENTONISCUS PRUINOSUS, new species.

Body oblong-ovate, 4 mm. long and 1½ mm. wide. Color reddish-brown with wavy lines of yellow on either side of the median line.

Head wider than long, with the front not margined. Antero-lateral lobes small; front slightly produced in the middle in a widely rounded lobe. Eyes very small, black, and situated about the middle of the lateral margin. The second antennæ have the first article short, the second and third subequal, and each a little longer than the first; the fourth is one and a half times longer than the third; the fifth is a little longer than the fourth. The flagellum consists of five articles, the third and fourth being rather indistinctly separated, and a long terminal spine equal in length to the flagellum.

FIG. 1.—PENTONISCUS PRUINOSUS.

The first segment of the thorax is a little longer than any of the following segments, which are subequal. The post-lateral angles of the last three segments are produced backward; those of the first four segments are rounded.

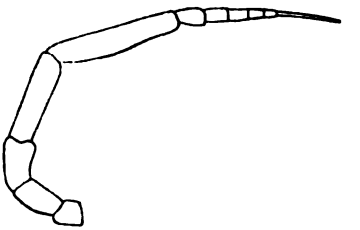


FIG. 2.—PENTONISCUS PRUINOSUS. SECOND ANTENNÆ.

The abdomen is abruptly narrower than the thorax. The lateral parts of the first two segments are concealed by the seventh thoracic

FIG. 3.—PENTONISCUS PRUINOSUS. MAXILLIPED.

FIG. 4.—PENTONISCUS PRUINOSUS. INNER LAMELLA OF SECOND MAXILLA.

FIG. 5.—PENTONISCUS PRUINOSUS. MANDIBLE.

segment. The post-lateral angles of the three following segments are produced backward in very acute angles. The first segment is a little shorter than any of the others, which are subequal. The sixth or terminal segment is triangular, with the apex rounded. The peduncle of the uropoda extends almost to the extremity of the terminal

Digitized by Google

abdominal segment. The branches are styliform, the inner being the shorter and about equal in length to the terminal abdominal segment; the outer branch is about one and a third times as long as the inner.

About 11 specimens were collected at Estrella, at an altitude of 2,000 meters, by Mr. Picado.

Locality 7.—One specimen at La Mica, in the mountains southwest of Orosé. Collected by Mr. Picado.

Locality 2.—Fourteen specimens at La Estrella, in the Bromelias, several meters from the ground. Collected by Mr. Picado.

Locality 6.—About 16 specimens at La Mica, in the mountains southwest of Orosé. Collected by Mr. Picado.

Locality 4.—About 30 specimens at Pitahaya (south of Cartago). Collected by Mr. Picado.

In color and color markings the new species is similar to *Porcellionides pruinosus* (Brandt).

Type.—Cat. No. 43771, U.S.N.M.

PHILOSCIA MUSCORUM (Scopoli).

Locality 3.—La Pitahaya (south of Cartago). (Color pattern typical.) Collected by Mr. Picado.

Locality 1.—La Estrella, in Bromelias, several meters from the ground. Collected by Mr. Picado. The color pattern is somewhat different in these specimens, there being a double series of light patches on each side of the mesosome, one series at the base of the side plates and the other on the outer side of the series of dark patches. The median dark band also has light patches.

Locality 5.—La Mica, mountains southwest of Orosé. (About the same as No. 1.) Collected by Mr. Picado.

Locality 6.—La Mica, mountains southwest of Orosé. The dark patches are almost entirely obliterated by the presence of the light patches. Collected by Mr. Picado.

Locality 2.—(Same as locality 1.) In some specimens the color pattern is the same as No. 1; in others the same as No. 6. Collected by Mr. Picado.

Locality.—Reventado. Collected by Mr. Tristan. In some specimens the color pattern is the same as No. 1; in others it is the same as No. 6; in others it is like No. 1, but with a transverse row of light spots on the posterior margin of each of the thoracic segments.

In some of the smaller specimens the first article of the flagellum of the second antennæ is not much longer than either of the other two articles.

In the male specimens the first two pairs of legs have the propodus somewhat more inflated than in the specimens of *Philoscia muscorum* from North America with which I have compared them.

Digitized by Google

The following were also collected by Mr. Picado:

Locality 8.—The specimens are like those from locality 3. Color pattern typical.

Locality 11.—Orosé, 1,200 meters altitude, July. The specimens are more like those from locality 8.

Locality.—Planton, 2,500 meters altitude, May. Similar to specimens from locality No. 1.

Locality.—La Estrella, 2,000 meters altitude, May. In one specimen the color pattern is typical. In two it is like those from locality No. 1. In two others it is still different, being more like No. 6.

ALLONISCUS, species?

Locality 4.—One imperfect specimen was obtained at Pitahaya, Costa Rica. Collected by Mr. Picado.

Digitized by Google

SOME FOSSIL INSECTS FROM FLORISSANT, COLORADO.

By T. D. A. COCKERELL,
Of the University of Colorado, Boulder.

When visiting the United States National Museum during the summer of 1911, I examined the collection of fossil insects, and picked out three undetermined species which were of special interest, asking permission to study them. These are reported on herewith. The specimens are from the Miocene shales at Florissant, Colorado, and form a part of the Gustav Hambach collection. I have added descriptions of two Hymenoptera collected at Florissant in 1912.

Order NEUROPTERA Linnæus.

Family HEMEROBIIDÆ Stephens, emend. Westwood.

The Hemerobiidæ, as understood by most authors, are divided by Handlirsch into several families, namely, Dilaridæ, Osmylidæ, Polystœchotidæ, Sisyridæ, Nymphesidæ, and Hemerobiidæ. Of these, the Hemerobiidæ proper are abundantly represented in the North American fauna, while (according to Banks, as shown by his recent catalogue) we have two species of *Polystœchotes*, one each of *Sisyra* and *Climacia* (Sisyridæ), and one of *Dilar*. The Osmylidæ are not represented. In the Miocene shales of Florissant we find instead one *Polystœchotes*, two Osmylidæ, and no Hemerobiidæ, Sisyridæ, or Dilaridæ. Probably not much importance should be attached to the apparent absence of several groups, but the existence of Osmylidæ, an Old World group, is significant, and in harmony with other facts, such as the occurrence of a species of Nemopteridæ in the shales.

Osmylus, although made the type of a distinct family Osmylidæ by Handlirsch, according to the more usual classification falls in Hemerobiidæ, where, however, it will at least typify a subfamily Osmylinæ.

Digitized by Google

Genus OSMYLIDIA Cockerell.

OSMYLIDIA REQUIETA (Scudder).

Osmylus requietus SCUDDER, Tertiary Insects N. America, 1890, p. 162.
Osmylidia requieta (SCUDDER), COCKERELL, Canadian Entomologist, vol. 40, 1908, p. 342.

Scudder described one of the Florissant Osmylids as *Osmylus requietus*. He prefaced his account [1] with the following remarks:

The species we have placed here agrees somewhat closely with the species from amber, *Osmylus pictus*, referred by Hagen to this genus, but differs from it in its lack of any diverse coloring in the wings, as well as in some minor points of the neuration, as in the distance of the outer series of gradate veinlets from the outer border of the wing, their regular connection with one of the basal branches of the radius, the regularity of the inner series of gradate veinlets, as well as the structure of the cubital region. The two Tertiary species, however, agree together, and disagree with the living types in the simple character of the costal nervules, the much smaller number of sectors, and the character of the basal half of the wing, where the sectorial interspaces are regular and broken by few and irregularly scattered cross veins, instead of being so numerously supplied as to break up the field into an almost uniform and minute reticulation. The two fossil species would therefore appear to form a section apart.

I found *Osmylus requietus* Scudder in the shale at station 13 of the Florissant region. The specimen agreed with Scudder's type, except that it was a little smaller, the wings 14 mm. long instead of over 15.

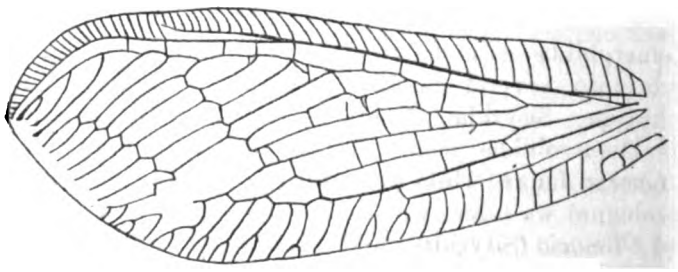


FIG. 1.—VENATION OF OSMYLIDIA REQUIETA (SCUDDER).

The insect differs conspicuously from typical *Osmylus* in the characters mentioned by Scudder, and on it I founded a new genus *Osmylidia*.[2] Whether the species from Baltic amber should be considered strictly cogeneric, I will not venture to decide. In many of its characters this genus resembles the very much older *Nymphites crameri* Haase, from the lithographic stone of Bavaria; indeed, it may fairly be said that *Osmylidia* is intermediate between *Nymphites* of the Jurassic and *Osmylus* of the present day.

[1] Tertiary Insects, p. 162.

[2] Can. Ent., vol. 40, 1908, p. 342.

Digitized by Google

This species is represented in the United States National Museum by a good specimen, showing the body, antennæ, and wings, and confirming the generic characters. I give a new figure of an anterior wing (fig. 1), kindly drawn for me by Miss June M. Ashley.

Plesiotype.—Cat. No. 58681, U.S.N.M.

Order LEPIDOPTERA Linnæus.

Family NYMPHALIDÆ.

Genus CHLORIPPE Boisduval.

CHLORIPPE WILMATTÆ Cockerell.

Plate 56, fig. 3.

Chlorippe wilmattæ COCKERELL, Canadian Entomologist, vol. 39, 1907, p. 361.

The specimen belonging to the United States National Museum is not so well preserved as the type, but it shows the abdomen and more or less of the hind wings. The abdomen is quite broad (largely as the result of pressure, no doubt), dusky, with the sutures rather broadly pallid. The venation of the hind wing is partly preserved and is as in *Chlorippe* and allied genera. The shape of the hind wing seems to have been as in normal females of the genus. It is difficult to make out the markings of the hind wing, but the submarginal pale band is faintly indicated, and the usual row of spots in the interspaces was evidently present, though apparently they were light, without dark centers. There are also indications of a pale spot at the base of the cell between the media and cubitus, one of the series of pale spots crossing the hind wing in males of modern *Chlorippe*.

Plesiotype.—Cat. No. 58682, U.S.N.M.

Order ORTHOPTERA Latreille.

Family MANTIDÆ.

EOBRUNERIA, new genus.

The generic characters are included in the description of the following species which is the type of the genus.

EOBRUNERIA TESSELLATA, new species.

Plate 56, figs. 1, 2.

Tegmen about 33 mm. long and 11½ mm. wide; the costal field about middle of tegmen one-third of total width. In the costal field are longitudinal brown bands, and on the lower two-thirds of the wing broad oblique ones, all broken up by cross veins into little square blocks. Although the markings, as shown in the figures, are

Digitized by Google

very distinct, the lens or microscope shows no additional details, and it is impossible to say more about the venation than that it appears to be perfectly normal for a mantid with a broad costal field, such as the female of *Stagmomantis limbata* (Hahn). The tessellated markings resemble those of the lower wings of *Stagmomantis* and other mantids.

I had taken this for a locustid, and made many efforts to find something similar in the modern fauna, both by examining the literature and consulting specialists in the group. Here I failed entirely, but Prof. L. Bruner, to whom I sent a photograph, remarked that the insect looked to him more like a mantid, and once having this clue I soon became convinced that it belonged to that family.

Holotype.—Cat. No. 58683, U.S.N.M.

Order HYMENOPTERA Linnæus.

Family PANURGIDÆ.

Genus LIBELLULAPIS Cockerell.

LIBELLULAPIS WILMATTÆ, new species.

Female.—Length 13½ mm., anterior wing about 8 mm.; rather robust; the head and thorax were apparently black, the abdomen pale (as preserved very pale reddish, with faint suffused bands, only that on the fourth segment conspicuous, the apex also a little darkened); head very broad, its breadth 5 mm., being the same as that of the thorax in the region of the wings; ocelli rather large; legs broadly hairy; abdomen with a heavy apical fringe of hair, but no ventral scopa; wings hyaline, reddish, stigma and nervures ferruginous; pygidial plate broad at base, then rapidly narrowing, but expanding apically, though of course much narrower there than at base.

Marginal cell long, pointed, though not very sharply, the point only a very short distance from costa; stigma rather well developed (considerably larger than in *Lithurgus*, etc.); two submarginal cells, the second very long, considerably longer than the first; basal nervure straight, except for a slight bend at its lower end; basal nervure meeting transversomedial, the latter strongly oblique, the lower end more apical; second submarginal cell receiving both recurrent nervures, the first some distance from the base, the other about one-fourth of this distance from the apex; second recurrent nervure with a gentle curve.

Hind wing with the venation ordinary, except that the distance from the upper end of the transversomedial nervure to the beginning of the discoidal cell is much less than the side of the discoidal cell on the median cell. (This peculiarity is also observed, though less pronounced, in *Panurgus*, especially *P. calcaratus;* the second submarginal cell is also very long in *Panurgus*.)

Digitized by Google

Wing measurements in microns:

Depth of stigma, about	368
Length of marginal cell	2,320
Width (depth) of marginal cell	528
Marginal cell on first submarginal	352
Marginal cell on second submarginal	880
Marginal cell from second (morphologically third) transversocubital nervure to apex	1,312
Basal nervure on first submarginal cell	400
Basal nervure on first discoidal cell (not allowing for curvature)	1,280
Length (diagonal) of first submarginal cell	1,408
Length of second submarginal cell	1,728
Second submarginal cell on first discoidal	480
Second submarginal cell on third discoidal	1,120
Second submarginal cell from insertion of second recurrent nervure to apical appendicular nervure	112
Second discoidal cell on third	592
Apical side of second discoidal cell below third discoidal	352

Hind wing:

Upper end of transversomedial nervure to basal corner of discoidal cell (352 in *L. antiquorum*)	880
Discoidal cell on median (not allowing for curvature) (640 in *L. antiquorum*)	1,216

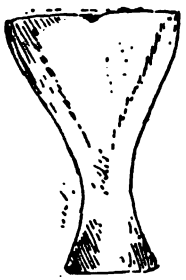


FIG. 2.—PYGIDIAL PLATE OF LIBELLULAPIS WILMATTÆ.

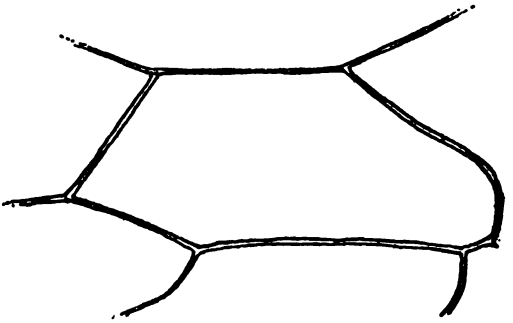


FIG. 3.—SECOND SUBMARGINAL CELL OF LIBELLULAPIS WILMATTÆ.

The lower side of the first submarginal cell is faintly arched downwards, but almost straight.

This seems certainly to belong to *Libellulapis*, which was based[1] on a species (*L. antiquorum* Cockerell) collected by Scudder in the Florissant shales. A reconsideration of the genus leads me to place in the Panurgidæ, where, by reason of certain features of the venation, it appears to stand rather near to *Panurgus*. The broad head, with prominent eyes, is also suggestive of certain forms of *Panurgus*. The pygidial plate is rather approached by that of *Dasypoda*.

In *Libellulapis* (both species) the side of the stigma on the marginal cell is practically straight; in *Pelandrena* (which has a proportionally

[1] Bull. Mus. Comp. Zöol., vol. 50, No. 2, 1906, p. 42.

Digitized by Google

larger stigma) it is convex; in *Biareolina neglecta* it is conspicuously angulate or subdentata about the middle.

Libellulapis wilmattæ is easily known from *L. antiquorum* by its much larger size.

Habitat.—Miocene shales of Florissant, at Wilson's ranch; collected July, 1912, by Wilmatte P. Cockerell.

Holotype.—Cat. No. 58688, U.S.N.M.

Family CEPHIDÆ.

Genus JANUS Stephens.

JANUS DISPERDITUS, new species.

Length 13 mm., but apex of abdomen (probably 1 mm.) missing; anterior wing 8¾ mm.; width of abdomen (flattened) 3⅓ mm., of thorax 3 mm.; the head was apparently black, or at least very dark; the thorax dark brown, but paler than head; the abdomen and legs apparently ferruginous; wings clear, with ferruginous nervures.

The venation of anterior wings agrees almost exactly with *Janus integer*, as represented by MacGillivray,[1] except as follows:

(1) The veins are more robust, like those figured by MacGillivray for *J. abbreviatus*.

(2) The first (basal) marginal cell has its basal corner very acute, more as in *Macrocephus*.

(3) The first recurrent nervure exactly meets the first transversocubital, also as in *Macrocephus*.

(4) The second recurrent meets the second transversocubital.

(5) The basal nervure on first submarginal cell is shorter, as in *J. abbreviatus*. (The relative positions of the basal and transversomedial nervures are exactly as in *J. integer*, not as in *Macrocephus*).

(6) The stigma is formed as in *J. abbreviatus*. (More robust than in *Macrocephus*).

(7) The third submarginal cell is very long, longer than in *J. integer*, and quite unlike the relatively short cell of *Macrocephus*. The following measurements are in microns:

Second submarginal cell on lower side	1,232
Third submarginal cell on lower side	1,232
Third submarginal cell on apical side	784
Third submarginal cell on upper side	1,072

What can be seen of the hind wing seems normal for the genus, but the apex of the median cell (subcostal of Marlatt) is more acute than in *J. integer*, herein rather resembling *Macrocephus*.

Miocene shales of Florissant; 1912. Collected by W. P. Cockerell at the Wilson ranch. This is the first fossil cephid from America. Among the European fossils, this must fall nearest to *Electrocephalus strahlendorffi* Konow, from Baltic Amber.

Type.—In the collections in the University of Colorado.

[1] Proc. U. S. Nat. Mus., vol. 29, pl. 43, fig. 93.

Digitized by Google

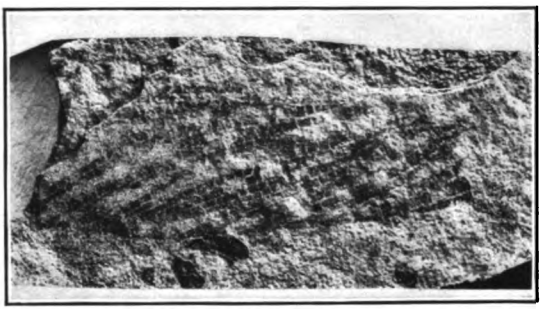


FIG 1.—EOBRUNERIA TESSELLATA, NEW SPECIES.

FIG. 2.—EOBRUNERIA TESSELLATA, NEW SPECIES.

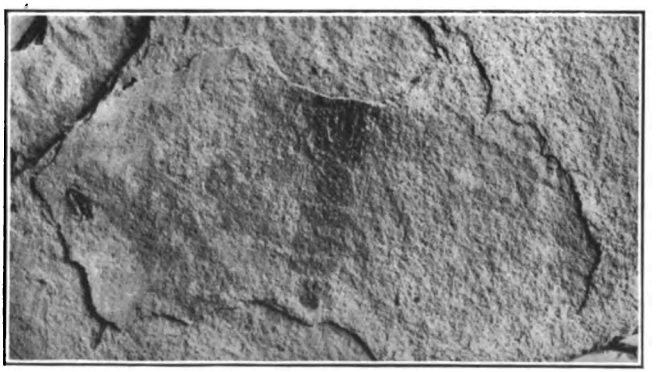


FIG. 3.—CHLORIPPE WILMATTÆ COCKERELL.

FOR DESCRIPTION OF SPECIMENS SEE PAGE 343.

Digitized by Google

Digitized by Google

RESULTS OF THE YALE PERUVIAN EXPEDITION OF 1911. ORTHOPTERA (EXCLUSIVE OF ACRIDIIDÆ).

By A. N. CAUDELL,

Of the Bureau of Entomology, United States Department of Agriculture.

The Peruvian localities mentioned in this paper are for the most part absent from printed maps and geographical indices. Most of the Orthoptera taken by the expedition were collected at a few localities in southeastern Peru. Pampaconas River, a locality given for a goodly number of species, is an uncharted stream flowing between the Urubamba and Apurimac Rivers.

By previous agreement representatives of all Orthoptera taken by the expedition and the types of all new species are deposited in the United States National Museum.

Family BLATTIDÆ.

CHORISONEURA PERUANA, new species.

Allied to *C. pellucida* Saussure, from Mexico.

Male.—Color a nearly uniform brownish yellow, the disk of the pronotum with the underlying part of the thorax showing through as a darker central portion. Pronotum broadly rounded anteriorly and behind almost truncate. Elytra extending much beyond the tip of the abdomen; wings with an apical area about as long as broad acuteangulate basally and apically extending barely beyond the tip of the costal field, broadly rounded and faintly notched mesially. Supraanal plate broadly transverse and very obtuseangulate apically; subgenital plate small and succeeded by a pair of upwardly directed, basally broadened styles. Legs slender, the femora unarmed beneath except with short bristles.

Length, entire from front of head to tip of elytra, 13 mm.; pronotum, 2 mm.; elytra, 11 mm.

Type.—One male, Huadquina, July 31, 5,000 feet altitude. Cat. No. 15046, U.S.N.M.

Digitized by Google

ISCHNOPTERA PAMPACONAS, new species.

A medium sized blackish red-brown species apparently differing from any described species recorded from Peru or surrounding regions.

Female.—Size medium; body depressed; form elongate, the closed wings surpassing the tip of the abdomen by fully a third their length; head not quite concealed beneath the pronotum; ocelli large and situated sublaterally next the inner-upper margin of antennal scrobæ next the eye; interocellar space broader than the interocular space, which is about as broad as the width of one eye; antennæ covered with fine short hairs. Pronotum narrowly rounded in front and broadly rounded behind, the sides deflexed, the disk dimpled on each side of the middle. Elytra long and slender, semi-coriaceous, the veins fairly distinct, the costal field long and narrow; wings in repose as long as the tegmina, transparent, the anterior field apically a little infuscated; ulnar vein with two complete branches extending to the apex and with seven or eight incomplete veins; there are more than a dozen costal veins, two or three of which are forked and many of them apically somewhat swollen. Legs slender, the anterior femora armed beneath on the front margin with three or four stout spines on the basal half followed on apical part by a row of fine short ones; arolia between the claws very small and inconspicuous, often hard to see. Supraanal plate considerably produced and apically rounded; subgenital plate broad and posteriorly broadly rounded, entire; cerci stout and long, finely haired.

General color a very dark-reddish brown, the pronotum almost uniformly black and the legs light yellowish, as are also the mouth and palpi. The ocelli are a transparent reddish, the antennæ brown and the costal margin of elytra is anteriorly a little lighter. The elytra are posteriorly a little more transparent and thus less dark.

Length, total from head to end of elytra, 18 mm.; pronotum, 3 mm.; elytra, 14 mm.; width, pronotum, 3.5 mm.; elytra at widest point, 4 mm.

Type.—One female Pampaconas River, August. Cat. No. 15047, U.S.N.M.

It may have been this species which Bolivar recorded from Peru [1] as *I. consobrina.*

ISCHNOPTERA IGNOBILIS Saussure.

One female, Pampaconas River, August.

[1] Anal. Soc. Espan. Hist. Nat., vol. 10, 1881, p. 466.

Digitized by Google

BLATTELLA STYLATA, new species.

A moderate sized species apparently somewhat allied to *B. peruana* Shelford and other species described by that author. In some of the characters, however, it differs from those given for any of the described forms.

Male.—Palpi with the last segment considerably enlarged basally and tapering from there to the tip, beneath brownish; antennæ slender and sparsely hairy. Pronotum truncate posteriorly, anteriorly very broadly rounded, the sides broadly translucid. Elytra extending distinctly beyond the tip of the abdomen and, except for the brownish cross veinlets, nearly uniform in color; wing with eleven apically swollen costal veins; ulnar vein five-branched, the first and second branches confluent apically. Femora all well armed beneath, the anterior ones armed beneath along the entire margin, the spines growing gradually shorter toward the apex. Supraanal plate broadly transverse, apically entire; subgenital plate large, slightly longer than broad and apically prolonged at each side as a style-like projection, which is apically armed with two or three very small but stout spines, and between these projections there are two apically more or less expanded asymmetric organs which are very finely serrate, or spined, on the inner margin; cerci long, stout, and strongly depressed.

Color clear yellowish brown, the disk of the pronotum with some small oblique black dashes and the cross veins of the elytra brown; abdomen beneath mesially fuscous to the base of the terminal segment and with smaller dark maculations along the margins; the tarsal joints, except the first, are partially black and the tibiæ on the outer side bear conspicuous black spots at the base of the spines; femora unicolorously yellowish brown except for small blackish spots at the base of the ventral spines beneath on the middle and hind pairs; the face has some blackish lines and dashes.

Length, entire from front of head to end of elytra, 14 mm.; pronotum, 3 mm.; elytra, 11 mm.; width, pronotum, 4.5 mm.

Type.—One female, San Miguel, September 1, 6,000 feet altitude. Cat. No. 15048, U.S.N.M.

PHŒTALIA LÆVIGATA Beauvois.

One male, Huadquina, July 30, 5,000 feet altitude; one female, same locality, July 31.

EPILAMPRA, species.

One male, one female, San Miguel, July 24, 6,000 feet altitude; one female, Lucma, August 7, 7,000 feet altitude; one female, Pampaconas River, August.

In the present state of our knowledge of the species of this genus it is scarcely possible to determine these specimens specifically. The female specimen from Pampaconas River has the elytra extending to

Digitized by Google

the tip of the abdomen, while in the other females they fall distinctly short of it; otherwise they are similar.

BLATTA TINCOCHACA, new species.

Female.—The smallest species of the genus known to me. Head moderately exposed, the eyes small and wide apart and very inconspicuous, the interocular space more than twice as broad as the space between the antennæ; ocelli scarcely noticeable; terminal segment of the palpi swollen basally, tapered apically. Pronotum truncate posteriorly, anteriorly subtruncate above the head and then, together with the sides, rounded. Legs moderately stout, the fore femora scarcely spined beneath, but the middle and hind ones quite strongly spined, the spines few in number; arolia between the tarsal claws small but distinct. Wings rudimentary; elytra short, about as long as the pronotum and posteriorly very broadly rounded, almost truncate, dorsally separated by a space equal to about one-fourth the width of one of them. Abdomen short and broad, the supraanal plate broadly triangular, about twice as broad as long, apically entire; subgenital plate valvular as in *Blatta orientalis* except the slit is more apical, extending a lesser distance toward the base.

General color black, the legs yellowish brown with the femora and tibiæ black at each end and the joints of the tarsi blackish; the abdomen is a little lighter below than above and the margins of the segments, especially beneath, are obscurely yellowish; pronotum and costal margin of elytra yellowish, about one-fourth of the elytral width occupied by this yellowish margin; head entirely black except a lightish tinge about the mouth parts, the eyes and vertex uniformly black, the eyes very inconspicuous; antennæ dark brown, nearly black, with the basal part growing yellowish.

Length, entire from front of head to end of abdomen exclusive of cerci, 6.5 mm.; width across widest part of abdomen, about 3.5 mm.

Type and paratype.—Two females, Tincochaca, August 8, altitude 7,000 feet. Cat. No. 15049, U.S.N.M.

OXYCERCUS PERUVIANUS Bolivar.

One female, Torontoy, July 22, 8,000 feet altitude.

DASYPOSOMA NIGRA Bruner.

Five female specimens ranging from apparently full grown to one less than one-half inch long. All from Urubama, Peru, July 11, 9,500 feet altitude.

Family PHASMIDÆ.

AUTOLYCA TRANSVERSATA, new species.

Allied to *A. picturata* Redtenbacher and runs to that species in the table of species in the works of that author.[1] The posteriorly

[1] Ins. Fam. Phasm., p. 95, 1908.

Digitized by Google

margined segments of the thorax and abdomen will readily separate these two species.

Male and female.—Head subquadrate, about as broad as long; antennæ of the usual structure, the basal segment flattened. Pronotum about the same in width and breadth, the mesonotum about twice as long as the pronotum and slightly broader; intermediate segment obscurely indicated, subequal in length with the metanotum from which it is usually separated by a couple of small subdorsal transverse light-colored spots. Abdomen moderately swollen in the female, in the male parallel sided, the segments transverse, female, or quadrate, male. Operculum of female nearly as broad as the segment of the abdomen from which it arises, reaching to the tip of the last segment and apically slightly acuteangulate; operculum of the male large, fully as broad as the last segments of the abdomen. Cerci of both sexes simple, short and stout, in the female straight, in the male almost straight. All the femora distinctly carinate, the anterior one almost straight, at the base very slightly curved; tibiæ also carinate, the sides sulcate; tibiæ generally lighter colored beneath and covered with fulvous pile. The whole insect is covered with short hairs or pile as is common in the genus.

General color velvet black, the antennæ ringed with whitish yellow and the segments of the abdomen and thorax posteriorly margined above with white. The tip of the femora is distinctly light colored, as is also the base of the tibiæ for a very short distance and the tip of the tibiæ and base of the first tarsal segment is more or less whitish. Clypeus also light yellowish.

Length, entire, male, 30 mm., female, 45 mm.; antennæ, male, 27 mm., female, all but 15 mm. gone; mesonotum, male, 5 mm., female, 8 mm.; fore femora, male, 9.5 mm., female, 11 mm.; cerci, male and female, 1.5 mm.

Holotype.—One male, Huadquina, Peru, July 26, 1911, 5,000 feet altitude.

Allotype.—One female, July 30, same locality; one male paratype, same data as the holotype. Holotype and allotype, Cat. No. 15050; U.S.N.M.

Family LOCUSTIDÆ.

DASYSCELUS, species.

One immature female. Pampaconas River, August.

This may be the *D. planiusculus* of Brunner, but the immature state of the only specimen represented prohibits its specific determination.

NANNOTETTIX PALTAYBAMBA, new species.

A species most nearly related to *N. guentheri* Brunner and running to that species in Brunner's tables. It differs, however, from *guentheri* in several particulars, besides being considerably larger.

Digitized by Google

Male.—Fastigium of the vertex elongate triangular, sulcate dorsally and not surpassing the antennal scrobæ; eyes moderately prominent; antennæ slender, much longer than the body. Pronotum ruggose both above and on the lateral lobes, truncate behind, subtruncate before, the anterior transverse sulcus distinct but not so conspicuous as the median sulcus; lateral lobes considerably longer than high, the lower margin straight, humeral sinus distinct but broad; no median nor lateral carinæ but the shoulders behind the median transverse sulcus are somewhat angular; disk anterior of the median transverse sulcus very finely sulcate longitudinally down the middle line; prosternal spines well developed. Legs moderately stout; anterior tibiæ with conchate foramina, the dorsal surface broadly and shallowly sulcate and unarmed; middle tibiæ similar to the front but armed on the posterior margin above with six small short stout sharp spines; both fore and middle tibiæ armed beneath on both margins; hind tibiæ armed beneath with a number of small spines in two series, those on the apical part situated opposite, those on the basal part further apart and alternate; above armed on both margins, an apical spine present only on the inner side; femora moderately stout, all the geniculations unarmed except those of the middle legs on the inner side which are spinose; all femora unarmed above, armed beneath with a single row of spines on the outer carina of the fore and middle legs and the inner side of the fore legs. Abdomen plump; subgenital plate elongate, apically narrowed and notched, each angle bearing a heavy style about four times as long as broad, apically rounded and barely tapering; cerci subspherical with a short sharply pointed curved tooth on the inner side; supraanal plate apically rounded, deflexed and broadly dimpled above.

Elytra very little longer than the pronotum, posteriorly rounded and with a well-developed speculum and distinct veins. Wings concealed beneath the elytra and equaling about two-thirds their length.

General color yellowish; head above with three longitudinal black streaks, the middle one extending anteriorly over the top of the fastigium of the vertex and the lateral ones smaller and extending from the top part of the eyes to the back of the head; the basal segment and scrobæ of the antennæ are mostly black and the face has blackish spots; the pronotum is wholly black in front of the anterior transverse sulcus and the shoulders and the middle of the posterior part of the disk is also black; all the spines of the legs and also the extremities of the femora and tibiæ are blackish; elytra blackish with conspicuous yellowish veins.

Digitized by Google

Length, entire from front of head to end of body, 32 mm.; pronotum, 9 mm.; elytra, 11 mm.; fore tibiæ, 11 mm.; fore femora, 10 mm.; hind femora, 24 mm.

Type.—One male. Paltaybamba, August, 5,000 feet altitude. Cat. No. 15051, U.S.N.M.

NANNOTETTIX PERUVIANUS, new species.

Male.—Similar to the last, but smaller and with longer wings. In Brunner's table of species it runs to *elongatus*, but it is a larger species than that more southern form. Head as described under *N. paltaybamba.* Pronotum rugose both above and on the lateral lobes, truncate posteriorly, anteriorly a little rounded, both transverse sulci distinct, about equally so, but neither conspicuous; lateral lobes distinctly longer than high, the lower margin straight, the hind margin almost straight and perpendicular, no distinct sinus present; no median nor lateral carinæ present but the shoulders a little angular; prosternal spines well developed. Legs moderate; anterior tibiæ with conchate foramina, the dorsal surface shallowly and broadly sulcate and unarmed; middle tibiæ flat above and armed on the posterior margin with four very minute sharp tubercles; both fore and middle tibiæ armed beneath on both margins; hind tibiæ armed beneath in the apical half with a number of spines, mostly in two series, above armed on both margins, an apical spine present only on the inner side, the last spine on the outer side being far removed from the apex; femora moderately stout, all the geniculations unarmed, all the femora unarmed dorsally and below narrowly sulcate, the outer margin of the hind and middle leg and the inner margin of the front ones thin and elevated and armed, the number of spines being four or five on the hind, two on the middle, and one on the fore femora, an additional aborted one showing on the left fore leg; the inner carina of the femora is less elevated, on the hind leg scarcely developed at all, and unarmed. Elytra twice as long as the pronotum but failing to reach the tip of the abdomen, apically narrowly rounded. Wings not quite as long as the elytra, completely concealed beneath them. Abdomen plump; subgenital plate and apical styles as in *paltaybamba;* cerci heavy, about three times as long as broad, round and apically bent inward and rapidly tapered to a sharp point.

General color yellowish; head above with two very fine postocular longitudinal streaks of black, and a similar one situated mesially, very small and on top spread into a cruciform spot; fastigium of vertex and the first two joints and the scrobæ of the antennæ mostly piceous and the eyes mottled with fuscous; upper margin of clypeus lined most of the distance with black and a descending outward curving line of the same color extends from the inner lower margin of the eyes to near the clypeal suture; extreme tip of mandibles

Digitized by Google

black. Pronotum with a longitudinal black band which spreads across the dorsal width on the fore and hind margins of the disk and extends down along the margins of the lateral lobes as a very fine line. Except for the black spines with dark reddish tips the legs are nearly uniformly brownish yellow, the posterior geniculations slightly infuscated.

Length, entire from front of head to tip of abdomen, 23 mm.; pronotum, 5.25 mm.; fore tibiæ, 8 mm.; fore femora, 8 mm.; hind femora, 15 mm.; elytra, 14 mm.

Type.—One male, Huadquina, July 30, 5,000 feet altitude. Cat. No. 15052, U.S.N.M.

NANNOTETTIX, species.

Two immature specimens, one male and one female, from same locality as *N. peruvianus* and with same data. If these nymphs are those of *N. peruvianus*, they show that species to be indeed variable, as these specimens are not like the adult in structure or coloration. The infuscation of the pronotum, instead of forming a median band, is dim and follows the location which the lateral carinæ would occupy were such present. The fastigium of the vertex and the two basal segments of the antennæ are scarcely infuscated instead of piceous as in the adult of *peruvianus* and the face is marked by four black spots and streaks. The anterior femora has three spines on the inner carina beneath.

Another immature specimen, a male from same locality but taken four days earlier, probably belongs to this genus. Here the whole insect is mottled with blackish, the antennæ and legs conspicuously annulate and the face solidly piceous and shining.

ANAULACOMERA MACULICORNIS, new species.

As indicated by the specific name, this species is separable from its allies by the black marked antennæ.

Male.—Fastigium of the vertex elongate triangular, abruptly narrowing about the middle and dorsally sulcate, the margins elevated and, on the posterior half, much thickened or swollen; the whole vertex is directed upward somewhat and the tip is very narrow and beneath it the apex is concave and meets the pointed facial vertex; the antennal scrobæ extend beyond the tip of the vertical fastigium. Eyes round, prominent, moderate in size. Pronotum flat longitudinally above but tending to transverse concavity between the somewhat sharp shoulders; lateral carina scarcely indicated except posteriorly; pronotal disk very broadly and roundly concave both before and behind, the lateral angles very broadly rounded; lateral lobes about as high as long, rounded below and behind, anteriorly nearly straight, the humeral sinus sharp and distinct; the sulci of the pronotum not conspicuous; on the posterior part of the disk there are a couple of

Digitized by Google

inconspicuous longitudinally disposed elevated ridges. Legs slender; anterior tibiæ with open foramina on each side, the dorsal surface slightly sulcate and armed about the middle with a small spine on either side and apically on the outer side with a spine so minute as to be barely visible in certain lights only;[1] middle tibiæ more distinctly sulcate above than the fore ones and unarmed on the outer margin, the inner margin with several small spines, the terminal one distinct; hind tibiæ distinctly longer than the corresponding femora and armed above and below with many stout spines on both outer and inner margins, apical spines above on both sides. All the femora armed beneath with a few serrations or teeth on one margin only, the geniculations short but acute. Elytra with fully two-thirds their length projecting beyond the abdomen, the wings surpassing considerably the elytra, the projecting part green and more opaque than the transparent membraneous portion; the elytra are narrow and slender with the veins inconspicuous, the margins nearly parallel and apically narrowly rounded. Abdomen moderate, short; subgenital plate mesially keeled longitudinally beneath, apically narrowed and squarely notched, the lateral angles long and styliform, not provided with free styles; supraanal plate broad and apically truncate; cerci cylindrical, seven or eight times as long as broad, gently curved inward and apically briefly and gently hooked, the tip forming a short stout naked tooth, the rest of the cercus hairy.

General color greenish; antennæ conspicuously marked on the inner side, except on the basal segment, with black for some distance at least from the base, the outer portion being absent in the only specimen seen. The elytra have several ocellate spots, composed of a number of minute dusky specks with a central black dot, and, especially along the anal margin, with many minute black specks visible only under a glass; the tympanal field is black with the central portion yellowish green; the hind tibiæ beneath has small black areas at the bases of the spines and the geniculations of the hind femora are infuscated.

Length, entire from front of head to end of wings, 38 mm.; fore femora, 6 mm.; middle femora, 9 mm.; hind femora, 18 mm.; hind tibiæ, 20 mm.; elytra, 32 mm.; wings beyond elytra, 4 mm.; width, elytra at middle, 5 mm.

Type.—One male, Pampaconas River August. Cat. No. 15053, U.S.N.M.

ANAULACOMERA SULCATA Brunner.

One male, Huadquina, July 30, 5,000 feet altitude.

[1] More material is necessary to determine if the fore femora are to be classed as with or without an apical spine.

Digitized by Google

PHYLLOPTERA FAMULA Brunner.

One male, Pampaconas River, August.

PHYLLOPTERA SERVA Brunner.

One male, Pampaconas River, August.

MICROCENTRUM PERUVIANUS? Scudder.

One female, Pampaconas River, August.

I have determined this specimen as *peruvianus* with some doubt, the type being of the opposite sex and unavailable for examination at this time, the determination being based on the description only, with which, however, this female agrees fairly well, allowing for sexual differences.

Family GRYLLIDÆ.

RIPIPTERYX RIVULARIA Saussure.

Two males, two females, Santa Ana, August 4, 3,000 feet altitude.

RIPIPTERYX FORCEPS Saussure.

Three males, one female, San Miguel, July 24, 6,000 feet altitude; one female, Lucma, August 7, 7,000 feet altitude.

This series shows that the yellow color of certain segments of the antennæ is not good as a specific character. The specimen from Lucma, which is just like the San Miguel specimens otherwise, has the antennæ unicolorously black, no segment showing any yellowish. One of the San Miguel females has the 6, 7, and 8 segments entirely yellow, while the other three have only the 6 and 7 so colored, and then often the apical part of one or both of these segments are black.

ANUROGYRYLLUS MUTICUS DeGeer.

One male, one female, two nymphs, Huadquina, July 26, 5,000 feet altitude.

The male has fully developed elytra but the wings are aborted, while in the female the wings are caudate.

ANUROGRYLLUS FUSCUS, new species.

A blackish species slightly above the usual size of its allies.

Female.—Head as broad as the front of the thorax, the eyes, ocelli, and mouth parts as in *muticus*. Pronotum a little broader than long, the lateral lobes bent gently inward on the posterior lower angle, the lower margin straight, descending slightly anteriorly, the fore and hind angles rounded; the anterior margin of the pronotal disk is very broadly and gently concave and the posterior margin correspondingly convex. Elytra as long as the abdomen and apically pointed; wings caudate, extending about half their length beyond the elytra. Legs moderate, the posterior metatarsus large, but little

Digitized by Google

swollen; upper inner calcar of hind tibiæ a little longer than the middle one and gently curved; the inner apical calcar of the posterior metatarsus is very large and almost half as long as the metatarsus, about twice as long as the outer calcar. Ovipositor rudimentary as usual in the genus.

Male.—Similar to the female except that the wings are aborted, the elytra, however, long and apically pointed as in the female. The lateral field of the elytra is also lighter and the lateral lobes of pronotum bear a fleck of yellowish on the lower front corner.

General color blackish above and yellowish beneath. The legs and mouth parts and venter of abdomen are yellowish brown, while the whole upper surface of head, thorax, and elytra is blackish brown, almost black; the wings and lateral field of the elytra are a little lighter than the dorsal surface; the lateral lobes of the pronotum are uniformly blackish; antennæ brown.

Length, from front of head to end of elytra, male and female, 20 mm.; pronotum, male and female, 4 mm.; elytra, male and female, 13.5 mm.; hind femora, male and female, 12.5 mm.; wing beyond elytra, female, 12 mm.; width, pronotum, male and female, 5.5 mm.

Type.—One male, one female, Pampaconas River, August. Type, female, paratype male. Cat. No. 15054, U.S.N.M.

The three species of this genus occurring in South America, one of which I consider as of varietal rank only, may be separated as follows:

Lateral lobes of pronotum uniformly yellowish or infuscated only centrally.
Vertex of head unicolorous.....*muticus* DeGeer.
Vertex of head marked by three or four longitudinal lines.
muticus var. *clarazianus* Saussure.

Lateral lobes of pronotum almost or quite uniformly blackish.. *fuscus*, new species.

All these forms are dimorphic in wing length, some having the wings caudate and others with them abortive.

GRYLLUS, species.

Eight immature specimens, two from Urubamba, July 15, 9,500 feet altitude; three from San Miguel, July 24, 6,000 feet altitude; three from Huadquina, July 14, 5,000 feet altitude. These may represent two or more species.

AMUSUS KIRSCHIANUS Saussure.

One female, Pampaconas River, August.

This is considerably smaller than the measurements given for the type, but otherwise fits the description very well.

ENEOPTERA SURINAMENSIS DeGeer.

One female, Santa Ana, August 4, 3,000 feet altitude.

Digitized by Google

Digitized by Google

Digitized by Google

A NEW EEL FROM JAPAN.

FOR EXPLANATION OF PLATE SEE PAGE 859.

Digitized by Google

DESCRIPTION OF ANGUILLA MANABEI, A NEW EEL FROM JAPAN.

By DAVID STARR JORDAN,
Of Stanford University, California.

During a recent visit to Japan the writer found, in the collection made by his former student, Mr. Yoshiro Manabe, for the Kwansei Gakuin (College) in Kobe, a species of eel apparently new to science. It may be described as follows:

ANGUILLA MANABEI Jordan, new species.

Plate 57.

Head 2 times in trunk and 6⅔ in length; 1½ in distance from mouth to dorsal; upper jaw 3 in head, extending much beyond eye; lower jaw slightly projecting; snout rather obtuse, flattish above, 5½ in head; eye 2½ in snout; distance from front of dorsal to vent 1⅝ in head; pectoral rather small, 3⅝ in head; distance from snout to dorsal 2⅝ in length. Color in alcohol, olivaceous, paler below, dorsal olive, anal pale, posterior edge of the continuous vertical fin somewhat darker.

This species is known from one specimen, the type (Cat. No. 74118, U.S.N.M.), 16¾ inches long, taken by Mr. Yoshiro Manabe in a rapid near Koyadaira, a village at the foot of Mount Tsurugi, in Awa, Shikoku. The tributary running north about 22 miles, joins the River Yoshino at Anafuki 22 miles distant from Tokushima, a large city at the mouth of the river.

Anguilla manabei seems nearest to *Anguilla aneitensis* described by Günther[1] from a single example from Aneitum. The dorsal fin in *A. manabei* is inserted, however, somewhat farther back than in *A. aneitensis*.

From the common eel or "Unagi," *Anguilla japonica*, found everywhere in the rivers of Japan, *A. manabei* differs widely. The head is much larger, the jaws longer, the eye and the pectoral smaller.

[1] Cat. Fish. Brit. Mus., vol. 8, 1870, p. 34.

Digitized by Google

Still more strongly, it differs in the backward insertion of the dorsal, which is not more than half a head's length in fron of the vent.

The species is named for Mr. Yoshiro Manabe, teacher of Zoology in the Kwansei College. The accompanying drawing was made by Mr. Manabe.

Comparison of measurements.

	A. japonica.	*A. manabei.*
Head in trunk	2¼	2
Head in length	3	6⅔
Upper jaw in head	3½	3
Origin of dorsal to vent in head	1½	1⅔
Pectoral in head	3½	3⅓
Snout to dorsal in length	3½	2⅔

Digitized by Google

DESCRIPTIONS OF NEW SPECIES OF AMERICAN FLIES OF THE FAMILY BORBORIDÆ.

By J. R. MALLOCH,

Of the Bureau of Entomology, United States Department of Agriculture.

The Borboridæ are small flies which have been much neglected by systematists. Even in Europe, where the Diptera have been most thoroughly studied, the species of this family are but imperfectly known. When carefully studied the species of this group present good generic and specific characters, and it is hoped that the following descriptions will contribute to a better understanding of the group.

APTILOTUS BOREALIS, new species.

Female.—Black, shining; frons subopaque; lateral, ocellar and vertical bristles as in the species of *Limosina*, center rows consisting of one strong, cruciate pair and an upper, and lower pair of much smaller, hairlike bristles, frons as long in center as three-fourths its central breadth, anterior outline centrally produced, basal joint of antennæ black, apical joint brown, the bristles on basal joint strong, pubescence on apical joint pale, arista brown, pubescent, one-third longer than breadth of frons at center, face black, subopaque, raised almost ridgelike longitudinally in center, in profile concave, the mouth margin produced, labrum protruding, mouth opening large, palpi small, proboscis not much reduced in size, cheeks black, opaque, below center of eye more than half as high as eye height, anterior bristle strong, posterior bristles weak and hairlike; thorax short, subquadrate, very slightly longer and narrower than head, bristles on mesonotum of moderate length, in regular rows, one distinct pair of dorso-central macrochaetæ, a very strong bristle on the lateral margins at posterior fourth, lateral margins with several weaker bristles anteriorly, pleuræ opaque black, the pleural bristle, so very conspicuous in *Limosina*, very much reduced in size, scutellum two-fifths as long as mesonotum, distinctly narrower, regularly rounded, with four marginal, subequal, equidistant bristles, five visible abdominal dorsal segments, the basal segment as in *Borborus* and *Limosina*, very short

Digitized by Google

and hidden, the abdomen oval in outline, first (visible) segment very slightly longer than second, next three subequal, last visible segment very short, all segments very finely granulose and with regularly distributed short dark hairs; anal organs yellowish; legs black, trochanters, extreme apices of femora, bases and apices of tibiæ, and all tarsi yellow, all legs with numerous short hairs, fore femora with a row of about seven hairlike bristles on postero-ventral surface which increase in length from base to tip, mid femora with a serial row of short close bristles on the antero-dorsal surface, the last two at near tip much the strongest, hairs on mid tibiæ almost bristlelike, one bristle at apical fourth on dorsal surface, apical spines weak, hind femora and tibiæ without any strong bristles, basal joint of hind tarsi distinctly dilated, covered with short stiff golden hairs on ventral surface, entire tarsus almost equal in length to tibia.

Length, 1½ mm.

Type.—Cat. No. 14945, U.S.N.M.

Two females, Farragut Bay, Alaska, May 6, 1899. (T. Kincaid, Harriman Alaska Exp.)

This species was recorded by Coquillett as *A. politus* Williston, which differs as follows: Head comparatively broader, frons glossy black, anteriorly much produced centrally, arista more tapering and less distinctly pubescent, face glossy, cheeks granulose, much higher than in *borealis*, head from anterior edge of eyes viewed from above about one-half as long as thorax, in *borealis* about two-thirds, mesonotum granulose, distinctly broader posteriorly than at anterior margin, scutellum more nearly subtriangular, at least one-half as long as mesonotum, abdomen glossy black, much more coarsely granulose than in *borealis*, the first visible segment distinctly longer than second, the hairs on surface much more sparse than in *borealis*, especially on basal two segments, the legs are bristled similar to those of *borealis*, but they are much darker in color in the female.

A male specimen of *Aptilotus politus* from Panamint Mountains, the type-locality, which is evidently one of the lot taken by Koebele, as it bears his label, differs from the female in having the frons as long as broad, regularly rounded and pale in front, the thorax not so distinctly broadened behind, the scutellum rather shorter, and the legs colored as in *borealis*. The hypopygium is large, longer on right side than on left, glossy black, and with numerous short black hairs on the surface. There is also on the mid tibiæ an additional preapical bristle, transversely situated to the one in the female. The species was briefly described from the female only, and though this example varies from that sex in several respects, I believe it belongs to *politus* and is not a distinct species. The question is one which can only be settled by obtaining sufficient material to afford an opportunity for comparison of the sexes. Unfortunately the type-specimens are not

Digitized by Google

in the collection. The only examples here are a female, compared with *borealis*, from Beulah, New Mexico (8,000 feet), May 3 (Cockerell), and the above-mentioned male.

SPHÆROCERA ANNULICORNIS, new species.

Male.—Black, slightly shining; frons opaque, only slightly shining laterally on posterior half (the lateral bristles have been destroyed, so that it is impossible to say anything about their disposition on frons); central rows very weak, pale, lying close on frons and strongly incurved; anterior outline of frons strongly produced in center; face strongly produced between and below antennæ so that the antennæ are situated in lateral cavities; labrum large, but not projecting much, except downward; a few weak, pale hairs on face margins; cheeks strongly rugulose, sides of mouth-margin shining, antennæ with basal joint yellow, second joint brown, twice as large as third, numerous short hairs on its surface, third clear yellow; the third joint sits in the hollow apex of second; arista one-third longer than breadth of frons at center, yellow, bare; thorax slightly shining, center rows of bristles with other two irregular rows between them; outer dorso-central rows irregular, not single; posterior half of dorsum with surface nearly entirely covered with short bristles; scutellum with discal short bristles, the posterior margin without tubercules or bristles; abdomen opaque, rugose, longer than broad, and nearly parallel-sided, bare; hypopygium large, strongly incurved, with numerous very short surface hairs; ventral surface of abdomen in center with distinct golden pubescence; legs black, shining, only the trochanters, knee-joints, apices of tibiæ and of all tarsi yellow; all legs with very short hairs; all femora thickened, especially the fore pair; hind tibiæ without the long curved apical spur present in *subsultans*, with only two short straight apical bristles; hind tarsi with the basal joint broader than tibiæ, longer than the next two, but not as long as the next three; wings yellowish, veins pale brown, costa bare, first division shorter than second, second slightly shorter than fourth and rather less than one-third as long as third; basal portion of third vein slightly shorter than second portion of fourth; third and fourth veins gradually convergent toward tip; inner cross vein at distinctly beyond end of first vein and at more than one-third from base of discal cell; outer cross vein at two and one-half times its own length from margin of wing measuring along fifth; fifth vein reaching four-fifths to margin of wing; halteres with stalk yellow and knob bright lemon colored.

Length, 4 mm.

Type.—Cat. No. 14946, U.S.N.M.

One male, Brookline, Massachusetts, March 20, 1874 (collection of C. V. Riley).

Easily separated from the other American species. From *pusilla* Fallen by its larger size and the absence of the scutellar tubercules as

Digitized by Google

well as the fact that the third and fourth viens do not diverge at apex. From *subsultans* Fabricius, by the absence of the strong thornlike apical spur on hind tibiæ, and from *bimaculata* Williston, by the unicolorous abdomen and the convergent instead of parallel third and fourth veins.

BORBORUS NEGLECTUS, new species.

Female.—Shining black; frons shining black except in front, where it is yellow margined, and the two lateral extremities of the pale portion which are carried posteriorly to ocellar triangle; central rows of bristles weak, divergent posteriorly and incurved; three strong lateral frontal bristles, the lowest slightly below, the second slightly above center of frons, a single weak hair between the lower pair; besides the usual two rows of central bristles, which stop much short of the ocellar triangle, there are on the pale stripes a number of weaker hairs; ocellar bristles strong, divergent; basal joint of antennæ black, with 4–5 long hair-like bristles; third joint brownish-yellow, twice as long as first, strongly but shortly pubescent; arista pale, pubescent, one and two-thirds times as long as breadth of frons; face yellowish above, brown below, shining; labrum much produced, brown, shining; occiput and cheeks shining, especially glossy beneath eyes, one very long bristle on mouth edge, and one moderately long, and numerous bristle-like hairs posterior to it; thorax shining, unstriped; pleuræ glossy black; scutellum with four marginal bristles, the anterior pair weak; abdomen glossy black, extremely broad and short, nearly circular in dorsal outline; basal segment very long, with raised longitudinal central, and hind-marginal transverse ridge; numerous lateral hairs present on basal half of segment, second segment slightly shorter than first, narrowed behind, numerous lateral hairs, a slight longitudinal central, and distinct transverse hind-marginal ridge; third segment short, not half as long as second, with lateral hairs; fourth segment pale yellowish-brown, shorter than third and much narrower, with numerous hairs; anal organ tawny, with longish hairs; venter tawny; legs yellow, except the bases of coxæ broadly and the femora except extreme bases and tips which are glossy black; apices of tibiæ and tarsi slightly browned; all legs with distinct, rather long hairs; fore femora with three or four distinct bristles on postero-dorsal surface; mid femora with a few rather stronger hair-like bristles on the antero-ventral surface; mid tibial hairs strong, two bristles on the dorsal surfaces at near tip besides the apical spines; hind femora very long and slim, distinctly bent, with strong hairs that are almost bristles on the antero-dorsal surface; tibiæ shorter than femora, with a distinct long bristle at near tip of dorsal surface; apical spur black, long, and curved; basal joint of tarsi distinctly broader than tibiæ, elongated on posterior external angle, second joint one-fourth longer and much thinner than basal joint; wings brownish, veins dark brown, costa

Digitized by Google

thickly haired, from base of wing to humeral vein two-fifths the length of second division of costa, second division less than one-third the length of third and equal to fourth, small cross vein at distinctly beyond end of first vein and slightly less than one-third from base of discal cell, basal portion of third vein longer than second portion of fourth, fifth vein not continued beyond outer cross vein, the angle of bend distinctly rounded, sixth vein very distinct to about midway from cross vein to wing margin, halteres reddish yellow.

Length, 3½ mm.

One specimen (female), labeled "Borborus," from Beverly, Massachusetts, April 4, 1867 (collection of C. V. Riley). Nearest to *nigrifemoratus* Macquart, but quite distinct.

Type.—Cat. No. 14947, U.S.N.M.

BORBORUS BREVISETUS, new species.

Male and female.—Opaque brown-gray; frons with center and lateral margins gray, the two stripes, where central rows of bristles are situated, opaque black, in male nearly entire center of frons darkened, the usual three lateral frontal bristles increasing in size toward vertex, and nearly equidistant, the third one incurved, the lower slightly outwardly directed over eye, vertical bristles strong, ocellar bristles strongly divergent, one or two hairs between lower pair of bristles, and a number on lateral margins of frons below the lowest bristle, central bristles distinct, strongly incurved, and reaching more than halfway to ocellar triangle, face gray, labrum only slightly produced, gray pollinose, the strong incurved long bristle midway between mouth margin and eye and a weaker one slightly posterior to and much lower than it, as well as several weak hair-like bristles posteriorly on the cheeks, lower occiput and eye-margin to near strong bristles shining, basal joint of antennæ with one long and several short hairs, third joint black, slightly gray pollinose at tip, at least twice as large as first, arista very short, barely two-thirds as long as breadth of frons at center, distinctly tapering and very slightly pubescent; thorax gray brown, with four regular rows of serial setulæ on the dorsum, and two rather irregular rows external to them on the lateral margins, two strong dorso-central macrochætæ, the center of thorax with a distinct brown stripe covering the insertions of the center pair of rows of setulæ, a narrower stripe along the line of the other pair of rows, a transverse brown mark behind the humeri and another in front of the wing base, as well as an interrupted brown longitudinal stripe from behind middle of dorsum to scutellum, scutellum dark on disk and pale on margin, with four equal-sized marginal bristles, lower two-thirds of sternopleuræ glossy black; abdomen opaque gray-brown, the basal segment slightly the longest, with numerous lateral hairs, terminal segment with

Digitized by Google

strong apical hairs, male hypopygium large, slightly shining and distinctly protruding, cleft on left side, with numerous long hairs on disk, anal organ in female densely covered with hairs; legs entirely gray-black, thickly covered with rather long hairs, fore femora thickened, the hairs on them more bristle-like, mid femora with a series of short bristles on antero-dorsal surface, and one strong one at one-fourth from tip, succeeded by a smaller one nearer to tip as well as the numerous hairs, mid tibiæ with a short, but distinct bristle at middle on antero-ventral surface, one on postero-dorsal surface at same place and three pre-apical bristles, one dorsal, one antero- and one postero-dorsal as well as two weak apical spurs, hind femora nearly straight, distinctly thicker than tibiæ, tibiæ with one bristle at about one-third from apex on antero-ventral surface, and one long pre-apical dorsal bristle, the end spur very long and sharp, basal hind tarsal joint as broad as tibiæ and two-thirds as long as the narrow second joint, the pubescence on ventral surface yellow in some lights; wings slightly grayish, veins brown, first costal division shorter than second in male, shorter than fourth and about one-fourth as long as third, second in female as long as fourth, inner cross vein slightly beyond end of first vein and less than one-third from base of discal cell, basal portion of third vein slightly longer than second portion of fourth, fifth vein distinct to halfway from outer cross vein to wing margin, sixth very distinct to more than midway to margin, halteres yellow.

Length, 2 mm.

One male, Washington, District of Columbia, April 28, 1912, on United States National Museum window (Malloch); one female, Las Vegas, New Mexico (Cockerell), 4,000 feet, June, 1901.

Type.—Cat. No. 14948, U.S.N.M.

BORBORUS LACTEIPENNIS, new species.

Male and female.—Black, shining; head buccate, the frons descending in front and very distinctly produced above antennæ, eyes small, at center barely higher than from lower margin to mouth margin across cheek, frons distinctly longer than broad at center, opaque black-brown, with the anterior margin and the central divergent stripes reddish, bristles rather hair-like, those on anterior margin and divergent stripes very numerous, long, and pale in color, basal joint of antennæ hidden under frons, third joint rounded, twice as long as basal joint, brown at tip, yellowish at base, one strong and several weak hairs on the upper surface of basal joint, arista as long as breadth of frons at center, pubescent, face yellow, produced at mouth margin, labrum slightly projecting, cheeks yellow, browned posteriorly, becoming merged into black toward occiput; the anterior bristle above mouth margin strong, those posterior to it very weak;

Digitized by Google

mesonotum shining black, with a slight olive tinge, the dorsal setulæ long, three pairs noticeably so, yellowish, pleuræ brownish, glossy on lower portions, scutellum with four marginal bristles; abdomen subshining, black, with pale posterior margins to segments, basal segment as long as next two, the others subequal in length, lateral and posterior marginal hairs sparse but strong, the latter present only on apical segments; male hypopygium large, knob-like, with scattered short hairs, and several long bristles at apex of dorsal plate, the ventral surface has numerous short hairs and the ventral organs are much paler in color than the dorsal plate; legs brown, trochanters, knees, and all tarsi yellow, all legs with numerous long hairs, anterior femora strong, a series of long bristles on apical two-thirds of ventral surface, mid femora and tibiæ as in *articus*, hind femora with three stronger bristles at from middle to near tip on dorsal surface, a long hair-like bristle at near base on ventral surface, hind tibiæ thickened, shorter than femora, with long hairs, the usual long dorsal bristle at near to apex, a distinct strong bristle and some long hairs at about apical third of antero-ventral surface, a series of about seven very long, fine, hair-like bristles on posterior surface from a little above middle to tip; those long hairs are absent in female; apical thorn-like spur long and strong, basal joint of hind tarsi dilated, two-thirds as long as second basal, which is slightly dilated; wings milk-white, costal vein yellowish, the other veins colorless, from humeral vein to end of first vein one-third as long as from end of first vein to end of second in male and barely as long as from second vein to third vein; in female the first mentioned is rather more than one-third the second and slightly longer than last-named division; inner cross vein distinctly beyond end of first vein and at one-fourth from base of discal cell; fifth vein reaching midway to wing margin beyond outer cross vein; sixth vein reaching two-thirds to wing margin; halteres whitish.

Length, 2 mm.

One male and one female, Tampico, Mexico (E. A. Schwarz).

Easily recognizable from any other described species by the white wings, the short arista, and the long hind tibial hairs in the male.

Type.—Cat. No. 14949, U.S.N.M.

BORBORUS ARTICUS, new species.

Male and female.—Greenish black, distinctly shiny; frons subshining except on the stripes where the small central bristles are situated, bristles situated as in *brevisetus*, a rather distinct bristle between the two lower lateral bristles, the hair-like bristles on central divergent stripes numerous and long though fine, frons distinctly projecting in front, face concave, produced at mouth margin, distinctly whitish

Digitized by Google

dusted, labrum distinctly protruding, shining, with slight dusting, antennæ black, basal joint with numerous hairs and no longer bristle above, third joint large, more than twice as large as basal joint, rounded, with very close, short pilosity, which is pale yellowish in color, arista not longer than breadth of frons, distinctly, but sparsely pubescent, cheeks below eyes glossy black, lower half opaque, anterior bristle very long, those posterior to it gradually decreasing in length, cheeks from mouth margin to lowest part of eye more than half as high as eye—taking both at center of eye—the eye is very small as compared with *brevisetus*, in which species the jowl, or cheek, is not more than one-third as high as eye at center; mesonotum unstriped, slightly gray-dusted, with four regular rows of dorsal setulæ, which are rather long but hair-like, pleuræ glossy black on lower portion, subopaque above, scutellum with four moderately long, marginal bristles, abdomen shining, basal segment in male as long as next two, second to fourth subequal, all segments with lateral, and last two with posterior, marginal, hair-like bristles, male hypopygium very large, knob-like, with complicated ventral processes, and with numerous hairs on the dorsal plate, female abdomen with basal segment only as long as one and one-half times second, the others subequal, bristled as in male; legs black, covered with very numerous black hairs, fore femora dilated, mid-femora normal, with one bristle distinct from the hairs at near apical third on anterior surface, mid-tibiæ with a similar bristle situated as on femora, two preapical bristles—one antero- and one postero-dorsal—as well as the apical spurs, hind femora normal in size, with 2–3 bristles more distinct than the hairs on the center of the dorsal surface, hind tibiæ slightly shorter than femora, with one long dorsal bristle at apical fourth, one on almost the ventral surface at near the apical third, and a long thorn-like curved apical spine, basal joint of hind tarsi much dilated, two-thirds as long as second basal, which is less distinctly dilated than basal; wings yellowish-brown, veins brown, from humeral vein to end of first vein one-third as long as from end of first vein to end of second and distinctly longer than from end of second to end of third; small cross vein not upright but sloped outward at upper extremity, distinctly beyond end of first vein and at less than one-third from base of discal cell, third and fourth veins slightly convergent toward apices, fifth vein reaching half way from cross vein to wing margin; halteres dusky yellow.

Length, 2 mm.

One female, Ungava Bay, one female and one male, Fort Chimo, Labrador (L. M. Turner).

A male from the District of Columbia, standing as *vitripennis* Meigen in collection, may belong to this species. It differs from the above description in having the tibiæ and tarsi yellow and seems to

Digitized by Google

have the legs more strongly haired, but the poor condition of the specimen, and the absence of the terminal joint of both antennæ prevent me deciding the status of the specimen. It is not *vitripennis* Meigen which is represented in the collection by several English specimens.

Type.—Cat. No. 14950, U.S.N.M.

LIMOSINA LUGUBRINA, new species.

Male.—Black-brown, shining; frons shining, tawny yellow, bristles normal, face and cheeks yellow, the former slightly concave and projecting beyond eyes, cheeks below center of eyes not one-third as high as height of eyes, anterior mouth marginal bristle strong, those posterior to it weak and sparse, antennæ yellow, basal joint with longish, black, terminal, internal hairs, third joint not larger than basal, with distinct pale pubescence, arista dorsal, about one and two-thirds as long as breadth of frons, dark in color and distinctly pubescent, mesonotum short, as broad as long, black-brown, paler at sides, and with a peculiar bronzy luster, scutellum broad, rounded, with four marginal bristles, pleuræ brown; abdomen shining black, basal segment rather longer than second, apical two segments with scattered long hairs, hypopygium not large, yellowish; legs yellow, mid tibiæ with one dorsal bristle at above middle and two at near tip on the antero- and postero- dorsal surfaces, no bristles on ventral surface; basal hind tarsal joint not much dilated, barely more than half as long as second, which is slightly dilated; wings brownish with an indistinct fascia beyond the end of second vein as in *lugubris*[1] Williston, but the venation is not as given for that species, the basal portion of third vein is slightly longer than last portion of second, the outer cross vein is distinctly longer than inner cross vein, and the fourth vein does not show beyond the outer cross vein; halteres whitish yellow.

Length, 1 mm.

Type.—Cat. No. 14951, U.S.N.M.

One male, Aguadilla, Porto Rico, January, 1899 (A. Busck).

The costal divisions in *lugubrina* are 1–1½–4. In Williston's description of *lugubris*[2] he states that the species has bristles on the under side (ventral surface?) of mid tibia, though I am not sure just what he means by that definition, and also that the third section of costa is three times as long as second. His figure gives the third section of costa as less than twice the length of second. He heads his description "male and female" and says in notes "one specimen."

[1] This name being preoccupied I have altered the name of the species to *sublugubrina* in Smiths. Misc. Coll. vol. 59, No. 17, p. 8.

[2] Trans. Lond. Ent Soc., 1896, p. 433.

Digitized by Google

LIMOSINA ROTUNDIPENNIS, new species.

Female.—Black, subopaque; frons opaque on divergent central stripes, slightly shining elsewhere, bristles strong and numerous, face brown, slightly shining, projecting, not concave, cheeks not half as high as eye, the anterior bristle on mouth margin of moderate length, succeeded posteriorly by one weaker and several very short hair-like bristles, antennæ black-brown, third joint slightly paler, not much larger than basal joint and slightly pointed, pubescence on third joint long, pale, basal joint with the usual dorsal, and apical bristles weak, mesonotum subopaque, with numerous short bristles, which are irregularly arranged, only one pair of distinct macrochaetæ, scutellum opaque, with four subequal, strong, marginal bristles, pleuræ brownish, opaque; abdomen opaque brown; legs brownish, the trochanters, tibiæ, and tarsi paler, no noticeable bristles except as in *niveipennis* (hind tarsi indistinguishable), wings rather short and rounded, grayish, costa brown, rather thick, noticeably so beyond end of first vein, from humeral cross vein to end of first slightly shorter than next costal division, both together as long as from end of second to third vein, basal part of third vein about one-third as long as last portion of second, outer cross vein distinctly before end of second, from outer cross vein to inner cross vein distinctly longer than basal portion of third and not twice as long as outer cross vein, third vein on last portion with a very slight upward bend, ending in front of wing tip, both fourth and fifth veins traceable beyond outer cross vein, the former distinctly so; halteres yellowish.

Length, 0.75 mm.

One female, Culebra Island, Porto Rico, February, 1899 (A. Busck).

Type.—Cat. No. 14952, U.S.N.M.

Allied to the foregoing.

LIMOSINA NIVEIPENNIS, new species.

Male.—Shining black; frons shining black, the central divergent stripes velvety opaque black, frontal bristles weak, face glossy brownish black, concave, cheeks shining but not glossy, anterior bristle above mouth strong, the others posterior to it much smaller and five in number, cheek below center of eye half as high as eye height, antennæ yellow, basal joint rather more than half as large as third joint, with one dorsal and five or six apical internal bristles, third joint slightly pointed, with long pale pubescence, arista dark, one and one-half times as long as breadth of frons, distinctly pubescent; mesonotum glossy black, the dorsal bristles long but hairlike, and in regular rows though not numerous, pleuræ glossy black, scutellum glossy black with four marginal bristles, the anterior pair much the weakest; abdomen brownish, hypopygium large, glossy, with numerous surface hairs;

Digitized by Google

legs black, trochanters, apices of femora, bases and apices of tibiæ, and tarsi yellow, all legs covered with short hairs, midtibiæ with 2–3 weak bristles at near apex on dorsal surface, basal joint of hind tarsi not greatly, though distinctly swollen, about two-thirds as long as second joint which is distinctly thinner; wings whitish, veins except costa almost colorless, from humeral cross vein to end of first vein equal to the next division of costa, both together equal to the last costal division, last section of second vein nearly twice as long as basal section of third, outer cross vein almost directly underneath end of second vein, fourth vein from inner cross vein to outer cross vein longer than basal part of third and twice as long as outer cross vein, last portion of third vein straight and ending almost at wing tip, fourth and fifth veins hardly traceable beyond outer cross vein; halteres dusky yellow.

Length, 1 mm.

One male, Mayaguez, Porto Rico, January, 1899 (A. Busck).

Allied to *lugubrina*.

Type.—Cat. No. 14953, U.S.N.M.

LIMOSINA PARVA, new species.

Male.—Shining black; frons raised in center, shining except on divergent central stripes, lateral bristles projecting over eyes, central bristles distinct, anterior outline of frons centrally produced, face slightly dusted, concave, mouth margin produced, anterior mouth marginal bristle strong, one weaker bristle and a few hairs posterior to it, cheek about one-third as high as height of eye, antennæ black, basal joint rather strongly bristled, third joint strongly whitish pubescent, distinctly but not greatly larger than basal joint, arista about one and two-thirds as long as breadth of frons at center, thin, black, distinctly pubescent; mesonotum shining black, with scattered short hairs, as broad as long, scutellum broad, not regularly rounded, with four marginal bristles; abdomen glossy black, the basal segment nearly as long as next two together, all segments bare on disk except the last and with lateral rather long hairs, hypopygium not very large, of normal shape, with scattered hairs; legs black, tibiæ and tarsi piceous, one weak dorsal bristle at basal third and two subapical on mid tibiæ, all legs with short hairs, basal joint of hind tarsi dilated, two-thirds as long as second joint which is slightly dilated; wings gray, from humeral vein to end of first vein shorter than next costal division which is one-half as long as last division, basal section of third vein about two thirds as long as last section of second vein, and equal to fourth vein from inner to outer cross vein, outer cross vein very slightly beyond end of second vein and twice as long as inner cross vein, last section of third vein slightly bent upward and ending dis-

Digitized by Google

tinctly before tip of wing, costa continued beyond end of third vein, fourth and fifth veins continued as short spurs beyond cross vein but not traceable to margin; halteres black.

Length, ½ mm.

One male, Washington, District of Columbia, on window of United States National Museum, top floor, April, 1912 (Malloch).

Allied to *exigua* Williston, but the color of the halteres is white in that species.

Type.—Cat. No. 14954, U.S.N.M.

Digitized by Google

THE SIPUNCULIDS OF THE EASTERN COAST OF NORTH AMERICA.

By JOHN HIRAM GEROULD,
Of Dartmouth College, Hanover, New Hampshire.

INTRODUCTION.

The large collection of sipunculids from off the eastern coast of North America that has been accumulating in the United States National Museum during the past 40 years, chiefly through the explorations of the United States Fish Commission and the present Bureau of Fisheries, has hitherto not been studied, and almost nothing has been known of the rich sipunculid fauna of the western part of the Atlantic.

The genus *Phascolosoma* has been thought to be represented in this region by three species only: *Phascolosoma gouldii*, a littoral form not uncommon in New England, *Ph. eremita* (=*boreale*), found in waters of medium depth off the New England coast, and *Ph. flagriferum*, an abyssal species. Eight others are now, from the study of this material, to be added to the list of Phascolosomas found off the eastern coast of North America, two of them being new species and another, *Ph. verrillii*, here for the first time fully described. The five remaining species (*margaritaceum*, *cylindratum*, *procerum*, *sabellariæ*, and *improvisum*) have not been recognized as belonging to the American fauna. *Ph. flagriferum*, mentioned above, originally described from a specimen taken by the *Challenger* from the deep sea eastward from Virginia, is again recorded as having been dredged by the U. S. Fisheries steamer *Albatross* in the same latitude, but nearer the Virginian coast.

The genus *Phascolion* is represented in the United States National Museum by an abundance of material from all parts of the eastern coast, exhibiting such a wide range of variation that the writer was at first inclined to describe several species. Prolonged and thorough study of this material, however, has led to the conclusion that all these variations should be referred to the single cosmopolitan species, *Phascolion strombi* (Montagu), with which *Phascolion cæmentarium* (Quatrefages) is identical, and of which *Phascolosoma* (=*Phascolion*)

Digitized by Google

tubicola of Verrill is one of seven recognizable varieties, which are described in detail in this paper.

The genus *Aspidosiphon*, which hitherto has not been described as occurring off the Atlantic coast of North America, is found to be represented here by two new species. A new deep-sea species is added to the genus *Physcosoma* (=*Phymosoma*), remarkable for the continuity of its longitudinal musculature. The range of *Dendrostoma alutaceum*, which has been known as a West Indian form, proves to extend northward to Cape Hatteras. *Sipunculus* is found to be represented not only by the cosmopolitan *S. nudus*, well known to occur off the coasts of North Carolina and Florida, but also by *S. priapuloides* Koren and Danielssen, a deep-sea species, the range of which off the American coast extends from the latitude of Charleston, South Carolina, northward to that of New York City. *Siphonosoma cumanense* (Keferstein) (=*Phascolosoma cumanense*=*Sipunculus cumanensis*), an interesting example of Spengel's new genus *Siphonosoma*, hitherto recorded from the coast of Venezuela and the West Indies, is found to occur also in Florida.

It may be inferred from the large amount of sipunculid material in the National Museum from numerous northern stations that the collection is fairly representative of the fauna of this group within the area extending from Labrador to Cape Hatteras. The subtropical region southward from the latter point, however, has been less thoroughly explored, though southern Florida, at least, is known to be inhabited by many interesting forms.

It is the purpose of this paper to make this fauna available to biologists by presenting such descriptions of external features and internal structure as are necessary for the easy determination of species, by pointing out the variability of certain plastic forms that are suitable for experimental work, and by bringing together what is known about the geographical distribution of the group between Labrador and Key West. Since the material at hand will not permit of an account of the sipunculids of the West Indian and South American region that would be at all complete, I shall here describe such subtropical and tropical forms only as have been found along the coast of Florida.

It would be a profitable study, however, if sufficient material were available, to compare with one another the sipunculids of the two sides of the Isthmus of Panama. *Physcosoma agassizii* (Keferstein), *Aspidosiphon truncatus* Keferstein, and *Dendrostoma peruvianum* Collin, have been found, so far as I know, only in the Pacific, while *Physcosoma pectinatum* (Keferstein) and *Ph. antillarum* (Grube and Örsted), *Sipunculus nudus*, and *S. titubans* Selenka and Bülow occur on both sides of the Isthmus. The exclusively Atlantic subtropical species inhabiting the region southward from Cape Hatteras through

Digitized by Google

the West Indies are, according to Selenka (1883), the following: *Phascolosoma dissors* Selenka and De Man; *Phascolosoma coriaceum* Keferstein; *Phascolosoma pellucidum* Keferstein; *Phascolion strombi* (Montagu); *Physcosoma varians* [1] (Keferstein); *Dendrostoma alutaceum* [1] Grube; *Dendrostoma pinnifolium* Keferstein; *Sipunculus robustus* Keferstein; *Sipunculus phalloides* Pallas; *Sipunculus cumanensis vitrea* [1] Selenka and Bülow (now *Siphonosoma cumanense*, see p. 432).

To this list of subtropical forms should be added *Phascolosoma cylindratum* Keferstein; *Phascolosoma cinereum*, new species; *Phascolosoma verrillii* Gerould; *Aspidosiphon parvulus*, new species; *Aspidosiphon speciosus*, new species.

The sipunculid fauna of the latitude of the Middle States between Cape Hatteras and southern New England includes *Physcosoma capitatum*, new species (lat. 38° 41′ N.); *Sipunculus priapuloides* Koren and Danielssen; *Phascolosoma cinctum*, new species; *Phascolosoma flagriferum* Selenka; *Phascolosoma margaritaceum* (Sars) var. *meridionalis*, new variety; *Phascolosoma procerum* Mœbius; *Phascolosoma verrillii* Gerould; *Phascolosoma sabellariæ* Théel; *Phascolosoma improvisum* Théel.

The boreal fauna extending northward from Long Island, New York, includes *Phascolosoma gouldii* (Pourtalès); *Phascolosoma margaritaceum* (Sars); *Phascolosoma eremita* (Sars); *Phascolion alberti* Sluiter.

Ubiquitous along the American coast from the West Indies to Labrador is *Phascolion strombi* (Montagu). Its range includes the whole of the Arctic and North Atlantic Oceans and the Mediterranean Sea.

The most distinctively abyssal species of *Phascolosoma* that have been found off the eastern coast of America are *Phascolosoma flagriferum* Selenka, which occurs in 1,700–2,620 fathoms, and *Ph. cinctum*, new species, found in 368–1,290 fathoms. Associated with the latter at the depth of 1,290 fathoms was *Ph. sabellariæ*. *Ph. eremita* (Sars), though commonly found in less than 100 fathoms, has been taken in 1,098; and *Ph. margaritaceum* (Sars), the typical form of which occurs off the Canadian and Newfoundland coasts in 30–75 fathoms, has a variety which I shall call *meridionalis* that has been taken off Marthas Vineyard in 705 fathoms. *Phascolosoma procerum* Mœbius has been found in 100–266 fathoms off our coast, its range apparently being somewhat restricted bathymetrically. It is found in the North Sea off Edinburgh, Scotland, as well as off the coast of the United States near the fortieth parallel. On the other hand, *Ph. sabellariæ* and *improvisum* off this continent have a wide bathymetric range, the former occurring from 70 to 1,098 fathoms, the latter from 5 to 810.

[1] The species indicated have been found along the coast of Florida.

Digitized by Google

In shallow water are found *Ph. verrillii* (4–16 fathoms) and *Ph. cinereum* (45 fathoms). *Ph. gouldii* (Pourtalès) and *Ph. cylindratum* Keferstein are the littoral representatives of their genus upon this coast.

Sipunculus nudus Linnæus and *Siphonosoma cumanense* (Keferstein) var. *vitrea* are both littoral species, but *Sipunculus priapuloides* Koren and Danielssen is found in 478–1,069 fathoms.

Phascolion strombi (Montagu) occurs at all depths from 5 to 1,061 fathoms, and *Ph. alberti* Sluiter at depths of 1,267–1,674 meters.

Physcosoma varians (Keferstein) and *Ph. antillarum* Grube and Örsted are littoral forms, but *Physcosoma capitatum*, new species, inhabits the sea bottom at 677–1,769 fathoms.

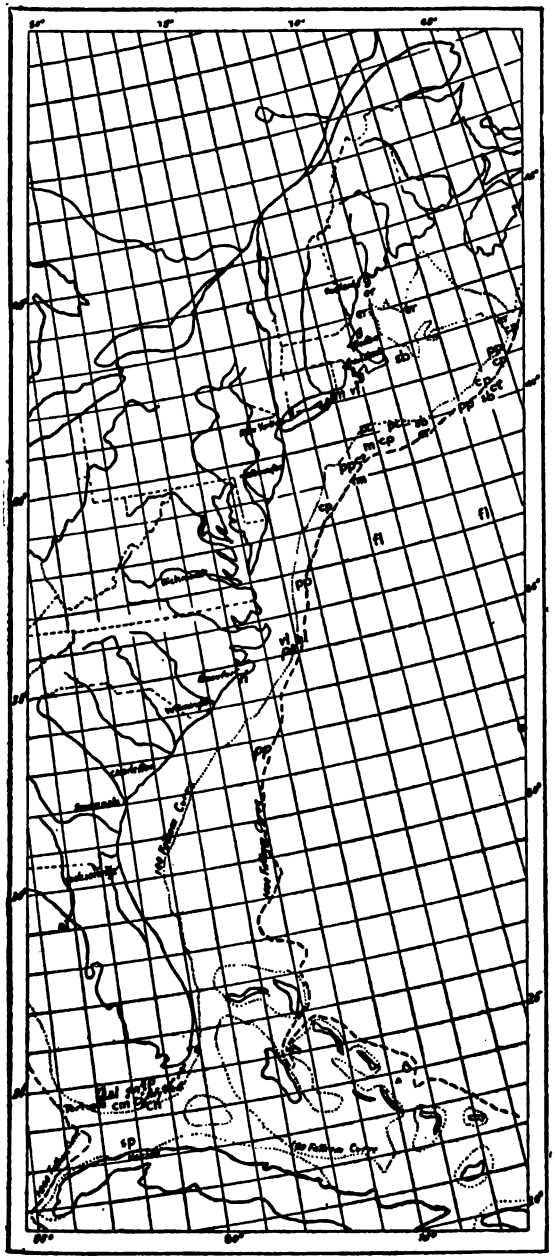
Aspidosiphon parvulus, new species, occurs in 16 fathoms; *A. speciosus*, new species, is found in the coral reefs near shore, and has been taken also at a depth of 157 fathoms.

Dendrostoma alutaceum Grube has a similar distribution among coral reefs near shore, and was taken off Cape Hatteras at a depth of 16 fathoms.

After plotting upon a map the principal localities at which sipunculids occur in the deeper waters off our coast (p. 377), I was interested to note how closely they follow the 1,000-fathom curve, the edge of the continental shelf. This is probably due in part to the fact that dredging operations have been carried on more extensively along this belt than elsewhere, but may it not possibly indicate that the conditions there, where the bottom rapidly descends from 100 to 1,000 fathoms, are exceptionally favorable for the life of sipunculids? *Sipunculus priapuloides*, *Physcosoma capitatum*, *Phascolosoma cinctum*, *Ph. procerum*, and *Ph. margaritaceum* var. *meridionalis* have been found only along this edge of the continental shelf; *Ph. eremita*, *Ph. sabellariæ*, and *Ph. improvisum* occur not only there but in shallower waters nearer the coast. *Phascolosoma flagriferum* alone occurs beyond the 1,000-fathom line, isolated in the deep sea.

Interrelationships of the genera.—The recognized genera of sipunculids are so closely anastomosed that it is difficult to define them sharply from one another. For example, *Ph. gouldii*, which is clearly a species of *Phascolosoma*, as is shown by its tentacles, integument, arrangement of its nervous system, and its development, differs from all other species of *Phascolosoma* and resembles all known species of *Sipunculus* in the division of its longitudinal musculature into separate bands. On the other hand, *Physcosoma capitatum*, new species, differs from all other known species of that genus in having a continuous layer of longitudinal muscle fibers, and in this respect it resembles the Phascolosomas. Yet it has the peculiar form of head and crown of tentacles, as well as other features characteristic of the genus *Physcosoma*, in which I have accordingly, though it must be

Digitized by Google



MAP SHOWING DISTRIBUTION OF ATLANTIC SIPUNCULIDS.

Abbreviations: *al*, alutaceum, Dendrostoma; *cm*, cinnamense, Siphonosoma; *cn*, cinereum, Phascolosoma; *cp*, capitatum, Physcosoma; *ct*, cinctum, Phascolosoma; *cy*, cylindratum, Phascolosoma; *er*, eremita, Phascolosoma; *fl*, flagriferum, Phascolosoma; *g*, gouldii, Phascolosoma; *im*, improvisum, Phascolosoma; *m*, margaritaceum, Phascolosoma; *n*, nudus, Sipunculus; *pa*, parvulus, Aspidosiphon; *pc*, procerum, Phascolosoma; *pp*, priapuloides, Sipunculus; *sb*, sabellarie, Phascolosoma; *sp*, speciosus, Aspidosiphon; *vl*, verrillii, Phascolosoma; *va*, varians, Phascolosoma.

Digitized by Google

confessed, somewhat arbitrarily, placed it. The unity or division of the longitudinal musculature, therefore, though it is a convenient and useful recognition mark, is not, in my opinion, as perfect a criterion of genera as the peculiarities in the form of the crown of tentacles

Phascolosoma is the central genus with which *Sipunculus* and *Physcosoma* are each almost inextricably connected. The same can be said of the relation of *Phascolosoma* to *Dendrostoma*, *Petalostoma*, *Phascolion*, and *Aspidosiphon*. *Dendrostoma* and *Petalostoma* [1] differ from *Phascolosoma* only in their tentacles and the accompanying vascular system, both of which are hypertrophied in *Dendrostoma* and atrophied in *Petalostoma*. *Phascolion* is like *Phascolosoma* as regards its tentacular and circulatory apparatus, though it has become asymmetrical and otherwise modified in adaptation to life in mollusk shells. *Aspidosiphon*, while in its extreme forms widely divergent from *Phascolosoma*, is nevertheless closely connected with this genus by intermediate species, as it is with *Physcosoma*.

It is of course always difficult to form a definite opinion as to whether a simple organism is primitive or the product of degeneration, and in many, if not in most cases, no final conclusion can be reached in the absence of paleontological evidence. From my work on the embryology of *Phascolosoma* I was inclined to the conclusion that the sipunculids are extremely primitive, unsegmented, annelid-like forms, and am still of that opinion; but a fuller acquaintance with *Siphonosoma cumanense* might possibly give credence to the view expressed by Selenka that they are degenerate annelids. *Siphonosoma cumanense* (Keferstein) has *Phascolosoma*-like tentacles combined with certain of the characteristics of the genus *Sipunculus* and, in my opinion, is a form of considerable morphological interest, because its cœlom is crossed by regularly arranged transverse folds of peritoneum that suggest the dissepiments of annelids. The regularity of their arrangement and their independence of the intestinal coil suggest that possibly they may not be newly evolved peritoneal folds, as appears to be the case, but perhaps represent vestiges of the septa of annelid ancestors. A thorough study of the development of this species, in any event, is much to be desired.

The characters used in distinguishing species among the sipunculids are remarkably variable. Hooks, even though of some service in classifying these species, are unreliable, for in the same species they may be present or absent. In *Ph. gouldii*, for example, I found (1906) a zone of minute hooks encircling the introvert of young individuals 3–6 cm. long and probably 1 year old, while none were found on slightly larger individuals 6.7 to 8 cm. in length. *Ph. gouldii*, however, naturally would be included among hookless species, since the

[1] See pages 392, 395.

Digitized by Google

adult has no hooks. *Phascolion strombi*, on the other hand, is a species regularly provided with hooks, but occasionally lacking them.

The retractor muscles, which I regard as a feature of a good deal of morphological significance, vary in specimens of *Phascolion strombi* from off the coast of Nova Scotia in having two roots to the dorsal retractor instead of the usual single line of attachment, different individuals from the same region showing each condition. The divided retractor is often associated in these specimens with a short introvert, so that a more or less distinct variety may be recognized, which occurs with the normal form and probably interbreeds with it.

Phascolion strombi, in general, is an extraordinarily plastic form, its external features, like color, thickness of the integument, shape, and number of the cuticular holdfasts, apparently depending almost wholly upon the character of the shell which the individual inhabits. Experiments in raising this species in shells of different kinds would be most interesting and instructive, and, as the animals can readily be kept in aquaria, such experiments would be practicable at any permanent marine zoological station.

The order in which the genera are described in this paper is intended to bring out, in general, the fact that *Phascolosoma* is the central or primitive genus from which the others have probably originated, though the interrelationships of the various genera can be expressed, of course, only very inadequately by a linear series. *Siphonosoma* naturally would precede *Sipunculus*, since it is intermediate in structure between *Phascolosoma* and *Sipunculus;* but for convenience in description Professor Spengel's new genus is here placed last. The sequence adopted in this paper is as follows: *Phascolosoma, Phascolion, Dendrostoma, Physcosoma, Aspidosiphon, Sipunculus, Siphonosoma.*

Genus PHASCOLOSOMA F. S. Leuckart.

Longitudinal muscle layer continuous (except in *Ph. gouldii*). Distinct finger-shaped or leaf-shaped tentacles encircle the mouth in one or more rows or groups, interrupted in the median-dorsal line by the ciliated nuchal organ. Hooks may or may not be present on the introvert. The intestine forms a double spiral coil of several, or many, whorls not fastened at the posterior end of the trunk. The pair of nephridia hang free. Four retractor muscles of the introvert, or only two (ventral). The contractile Polian vessel in most cases is simple, seldom having cæca. An anterior columellar or spindle muscle usually occurs. A pair of photic tubes lead backward from the surface of a cerebral sense organ into the substance of the cerebral ganglion. The bottom (or posterior, blind end) of each of these tubes, when pigmented, forms an "eye spot."

The yolk-laden prototroch cells of the trochophore atrophy during metamorphosis, and their substance passes in granular form into the cœlom of the larva.

Digitized by Google

SYNOPSIS OF SPECIES.

- Four retractors....
  - Longitudinal muscles discontinuous..... *gouldii* (Pourtalès).
  - Longitudinal muscles continuous;
    - No hooks on introvert..... *margaritaceum* (Sars).
    - Hooks on introvert..... *cylindratum* Keferstein.
- Two retractors.....
  - Hooks absent.....
    - *procerum* Mœbius.
    - *eremita* (Sars).
    - *eremita*, new var. *scabra*.
    - *verrillii* Gerould.
    - *flagriferum* Selenka.
    - *sabellariæ* Théel.
    - *improvisum* Théel.
  - Hooks present.....
    - *cinereum*, new species.
    - *cinctum*, new species.

PHASCOLOSOMA GOULDII (Pourtalès).

Sipunculus gouldii POURTALÈS, 1851.
Phascolosoma gouldii DIESING, 1859.

This common littoral species is found along the coast of New England from Casco Bay southward to the coast of Connecticut (New Haven), and on Long Island, New York (Cold Spring Harbor). It occurs somewhat locally in patches of muddy sand slightly above, or more commonly below, the low-water mark; and small individuals have been taken from Vineyard Sound with *Ph. verrillii* at a probable, though unrecorded, depth of several fathoms. The worms burrow vertically and obliquely in irregular fashion into the sand, to a depth of more than a half meter in summer.

This species, the structure of which has been fully described by Andrews (1890) and the development by Gerould (1896), requires no description here. I have elsewhere pointed out (1896, p. 147) that the division of the longitudinal musculature into distinct bands, which is a peculiarity that distinguishes this species from other Phascolosomas, is not an adequate reason for separating it from closely allied species of *Phascolosoma* and placing it in the genus *Sipunculus*, as Pourtalès, its earliest describer, Selenka, and others have done. In structure and development it much resembles *Phascolosoma vulgare* Blainville, the common littoral species of Europe. Its nearest ally in this country is *Ph. margaritaceum* (Sars), an inhabitant of deeper waters and extending northward, but also represented off our coast in the latitude of southern New Jersey by the variety *meridionalis*, the elongated form of which variety, as well as the integument and internal structure with the exception of the longitudinal muscles, resemble closely the corresponding features in *Ph. gouldii*.

Digitized by Google

PHASCOLOSOMA MARGARITACEUM (Sars).

Sipunculus margaritaceus SARS, 1851.
Phascolosoma oerstedii KEFERSTEIN, 1865.—THÉEL, 1875.
Phascolosoma fulgens THÉEL, 1875 (young?).
Phascolosoma albidum THÉEL, 1875 (young).
Phascolosoma margaritaceum KOREN and DANIELSSEN, 1877.

Specimens were taken from the following localities off the coast of North America:

Station 2463, Green Bank, south of Newfoundland, lat. 45° 44′ N.; long. 54° 27′ W.; 45 fathoms, broken shells; temperature at bottom, 30° F.

Station 2466, Green Bank, south of Newfoundland, lat. 45° 29′ N.; long. 55° 24′ W.; 67 fathoms, coral; temperature at bottom, 30° F.

Gulf of St. Lawrence, J. T. Whiteaves, 1872; 30 fathoms. (Hitherto erroneously referred to by Verrill, 1874, and others as *Ph. boreale.*)

Station 2491, Misaine Bank, east of Cape Breton, lat. 45° 24′ 30″ N.; long. 58° 35′ 15″ W.; 59 fathoms, white sand.

Station 2492, Misaine Bank, east of Cape Breton, lat. 45° 22′ N.; long. 58° 43′ 45″ W.; 75 fathoms, white sand; temperature at bottom, 33.3° F.

Gloucester Donation 803, western edge of Grand Bank, schooner *Gatherer*, August 16, 1881.

Characteristics.—Smooth, firm skin of pearl gray color, lustrous in some specimens. Introvert brownish-gray in alcoholic specimens. Four retractors, no hooks on the introvert, no eye-spots. It can readily be distinguished from *Ph. gouldii* by the continuous layer of circular muscles of the body wall and by the shortness and greater thickness of the trunk.

In form and proportion (pl. 58, fig. 1) it resembles *Ph. eremita* (Sars), and especially smooth and lustrous specimens of the latter without internal examination might be mistaken for this species, but *Ph. eremita* has a rougher skin, marked with parallel ridges and furrows especially evident at the posterior extremity of the body, and the trunk is usually brownish, rather than pearl-gray. The two species can be readily distinguished otherwise by the fact that *Ph. margaritaceum* has four retractor muscles, *Ph. eremita* two.

Distribution.—Théel (1905) describes *Ph. margaritaceum* as a true Arctic form, possibly with a circumpolar distribution. A western variety occurs off Greenland, Spitzbergen, Norway (Finmarken), Russia (Kola Peninsula), and Nova Zembla; an eastern variety is found north of Siberia and in Bering Strait.

It is much less abundant off the coast of North America than *Ph. eremita* (Sars), but occurs at depths from 30 to 75 fathoms off Newfoundland and the Canadian coast.

Digitized by Google

PHASCOLOSOMA MARGARITACEUM var. MERIDIONALIS, new variety.

Station 2749, lat. 39° 42′ N.; long. 71° 17′ W.; 705 fathoms, gray ooze; temperature at bottom, 38.7° F. One specimen, type.

Fayal Island, Azores, gravelly beach, lat. 38° 30′ N.; long. 28° 40′ W. Six specimens.

Type.—Cat. No. 4003, U.S.N.M.

This southern variety of *Ph. margaritaceum* occurs near the fortieth parallel on both sides of the North Atlantic, inhabiting the edge of the American continental shelf, 705 fathoms, in a region approximately south of Newport and east of Philadelphia; occurring also at Fayal Island, one of the Azores, where it burrows in a gravelly beach. The specimen from off the coast of the United States differs little except in size from those from the Azores.

The only marked difference between this variety and the typical form in northern waters is the extremely elongated shape, in which respect it resembles *Ph. gouldii*, or the two European species, *Ph. vulgare* and *Ph. elongatum*, more than the typical form. The introvert has the same pearly gray color as the trunk and not the brownish hue seen on the introvert of the typical form. The skin in a state of contraction shows distinct, though minute, papillæ. These are especially evident near the anterior end of the partially contracted introvert. The coils of the intestine are extraordinarily numerous in the large specimen from deep water (station 2749). The dimensions of this specimen are: Length of the trunk behind the anus, 85 mm.; introvert estimated at somewhat over 35 mm., probably half the length of the trunk; thickness of the trunk about 8 mm. The specimens from Fayal are about one-third as large as the specimen from station 2749.

One individual from Fayal lacks the left-dorsal retractor muscle.

Ph. capsiforme Baird is a small Antarctic species closely allied to *Ph. margaritaceum* (Sars). Geographically the variety just described occupies an intermediate region. Inhabiting waters of the Temperate Zone, its form resembles that of other Phascolosomas of this zone, rather than the oval form characteristic of the Arctic and northern type of this species and of *Ph. eremita* (Sars). It seems not impossible that the variety *meridionalis* may be a hybrid between the typical *Ph. margaritaceum* and *Ph. vulgare* or, possibly in the case of the Azores stock, *Ph. elongatum*.

PHASCOLOSOMA CYLINDRATUM Keferstein.

Key West, Florida (Henry Hemphill, 1885). Three specimens.

Recorded previously only from the Bermudas, Keferstein (1865).

This small, littoral species (pl. 58, fig. 2) is easily distinguished by its smooth, light yellowish-brown surface, the rows of hooks behind its

Digitized by Google

finger-shaped tentacles, its cylindrical trunk and short introvert, and, internally, by the presence of four retractor muscles.

The length of one well-expanded specimen is: Trunk, 16 mm.; introvert, 5 mm.; another has a trunk 20 mm. long. The length of the introvert is therefore slightly less than one-third that of the trunk. The thin, smooth skin of the trunk is everywhere studded with minute epidermal organs, which are most clearly seen at the posterior end of the body, where the epidermis is marked off into small, squarish blocks, each containing a rounded epidermal organ. Slightly in front of this region the epidermal organs have an elliptical contour, as described by Keferstein. In most cases they do not rise above the general surface, though some of them near the posterior end of the trunk are capped with exceedingly minute papillæ. The larger part of the anterior half of the introvert is covered with about 20 distinct circlets of hooks. The anterior rows are more widely separated than the posterior, and consist of slender, curved, yellowish-brown hooks with dark-colored tips. The smaller, posterior hooks are less regularly arranged in circlets. Keferstein found 20 long thread-like tentacles. The one specimen which I examined had only 16, and they were short and finger-shaped, with a prominent longitudinal furrow along the oral surface of each, but they may have been somewhat contracted.

The dorsal retractors, which are more slender than the ventral, are attached to the body wall opposite the anus, and slightly behind the nephridial openings; the ventral retractors arise near the posterior end of the first third of the length of the trunk. There are numerous intestinal coils (25–30) which are free behind, though Keferstein notes that they are held behind and in front, respectively, by a pair of muscle strands. The rectum is very short. There is a short, simple contractile tube. The intestine is filled with calcareous particles—grains of coral sand.

PHASCOLOSOMA PROCERUM Mœbius.

Specimens were taken from the following localities off the American coast:

Station 871, lat. 40° 02′ 54″ N.; long. 70° 23′ 40″ W.; 115 fathoms, mud and fine sand; temperature at bottom, 49° F. One specimen.

Station 943, lat. 40° 00′ 00″ N; long. 71° 14′ 30″ W.; 157 fathoms, mud, sand, shells; temperature at bottom, 49° F. Three young specimens.

Station 946, lat. 39° 55′ 30″ N.; long. 71° 14′ 00″ W.; 247 fathoms, green mud and sand; temperature at bottom, 47° F. One specimen.

Station 949, lat. 40° 03′ 00″ N.; long. 70° 31′ 00″ W.; 100 fathoms, yellow mud; temperature at bottom, 52° F. One specimen.

Station 999, lat. 39° 45′ 13″ N.; long. 71° 30′ W.; 266 fathoms, green mud. One specimen.

Digitized by Google

A specimen of this large gray *Phascolosoma* (pl. 58, fig. 3) was dredged at each of the above-mentioned localities off Marthas Vineyard at depths from 100 to 266 fathoms. In all respects except size they resemble those from Bass Rock near Edinburgh described by Mœbius, but the largest specimen from off Marthas Vineyard is five times the length of those from the North Sea. It has also been found at several places off the west coast of Sweden, according to Théel (1905), at depths of from 9 to 35 fathoms. In that region also its size is diminutive compared with that of the American specimens.

Characteristics.—The total length of the largest individual is 180 mm., of which the trunk behind the anus is 75 mm.; thickness of the trunk, 10 mm. The introvert is about 2½ times as long as the trunk, and one-third as thick. The posterior extremity of the body is prolonged into a slender, tail-like process, which in one specimen is about half as long as the thickness of the trunk, or about 5 mm. Color gray, the introvert of one specimen being slightly iridescent. The cuticula is thrown up into fine, wavy folds. Both trunk and introvert are covered sparsely with minute, dark-brown papillæ. The two (ventral) retractors have their origin at the extreme posterior end of the body (pl. 59, fig. 8). The pair of nephridia are attached slightly in front of the anus, and hang entirely free. Their surface is slightly rough. The esophagus is long; the rectum very short; the intestine has many coils closely held to the walls of the body. The Polian tube (contractile vessel) is covered with branching tufts that adhere to the dorsal wall of the body.

A notable feature of the nerve cord in two specimens that I have dissected is its submergence beneath the longitudinal muscle layer near the posterior end of the body, so that it is apparently interrupted. This disappearance begins slightly in front of the posterior end of the retractor muscles and extends forward nearly to the free ends of the nephridia. The retractors in this region are closely applied to the layer of longitudinal muscles, and united with them. Théel's (1905) beautiful figures of this species as it appears off the west coast of Sweden, however, show that the fusion of the retractor muscles to the body wall and the submergence of the nerve cord beneath the longitudinal muscles near the posterior end of the body, as described above, are not characteristic of the Swedish and North Sea representatives of this species, and it is perhaps not a constant characteristic in those of the western Atlantic.

According to Théel the tentacles are arranged in six groups, varying in number from 28 to 40. The skin immediately behind the tentacles is thin and smooth, not covered with the chitinous cuticula like the rest of the body, from which a collar or fold marks off this smooth zone.

Digitized by Google

PHASCOLOSOMA EREMITA (Sars).

Sipunculus eremita SARS, 1851.
Phascolosoma boreale KEFERSTEIN, 1865.—VERRILL, 1874.
Sipunculus (Phascolosomum) borealis QUATREFAGES, 1865.
Phascolosoma eremita KOREN and DANIELSSEN, 1877.—SELENKA, 1883.—THÉEL, 1905.

Specimens were taken from the following localities off the American coast:

Station 2698, south of Newfoundland, lat. 45° 07′ N.; long. 55° 09′ W.; 90 fathoms, gray sand, pebbles.

Station 2486, east of Banquereau, Nova Scotia, lat. 44° 26′ N.; long. 57° 11′15″ W.; 190 fathoms, coarse sand and gravel; temperature at bottom, 39.7° F.

Station 2507, off Halifax, Nova Scotia, lat. 44° 27′ 30″ N.; long. 62° 33′ 30″ W.; 80 fathoms, hard bottom; temperature at bottom, 41.6° F.

Station 2497, off Cape Canso, south of Cape Breton, lat. 45° 04′ N.; long. 59° 46′ 45″ W.; 57 fathoms, yellow sand, broken shells, hard; temperature at bottom, 33° F.

Casco Bay, 1873; 48–64 fathoms.

Station 21B, Cashes Ledge, lat. 42° 49′ N.; long. 68° 50′ W.; 52–90 fathoms, rocky bottom; temperature, 43° F.

Station 78B, east of Isles of Shoals near Jeffreys Ledge, lat. 43° 04′ N.; long. 70° 30′ W.; 35 fathoms, blue clay, mud, sand; temperature at bottom, 43° F.

Station 161, off Cape Ann, a little south by west of lat. 42° 36′ N.; long. 70° 27′ W.; 54 fathoms; temperature at bottom, about 39½° F.

Station 216, off Cape Ann; 35 fathoms, sandy.

Station 184, off Cape Ann, a little northeast of lat. 42° 30¼′ N.; long. 70° 38′ W.; 45 fathoms, mud; temperature at bottom, 42½° F.

Station 2523, east of Georges Bank, lat. 41° 48′ 30″ N.; long. 65° 44′ 30″ W.; 111 fathoms, sand, gravel, stones; temperature at bottom, 41.6° F.

Station 2524, east of Georges Bank, lat. 41° 48′ 45″ N.; long. 65° 47′ W.; 85 fathoms, sand, gravel, stones; temperature at bottom, 42.6° F.

Station 891, south of Marthas Vineyard, lat. 39° 46′ N.; long. 71° 10′ W.; 480 (?) fathoms, soft brown mud.

Station 2052, south of Georges Bank, lat. 39° 40′ 05″ N.; long. 69° 21′ 25″ W.; 1,098 fathoms, Globigerina ooze; temperature at bottom, 45° F.

This species is found from Spitzbergen and Greenland eastward to Nova Zembla and the Kara Sea (Théel, 1905). The southernmost point off the Scandinavian coast at which it has been taken is Bodö, north of the Arctic Circle (Koren and Danielssen, 1875, 1877, cited

Digitized by Google

by Théel, 1905). It is remarkable that this characteristically Arctic form extends southward along the American coast in shallow water as far as Massachusetts Bay, and in deeper waters as far south as about 40° north latitude.

Specimens that I have examined from the extreme north (South Gatt, northwestern Spitzbergen, latitude 79° 40′ N., 7 fathoms, and others from Spitzbergen Sea dredged by the U. S. S. *Alliance* in 1881) do not differ materially from those found in Massachusetts Bay.

It occurs usually at depths of less than 100 fathoms, though Théel records a specimen from Umanak, Greenland, from 200 fathoms, and it has been found south of Cape Cod in 480 and 1,098 fathoms.

The specimens in the United States National Museum differ only in minor details (size, color) from Keferstein's (1865) description of *Ph. boreale*, which has been identified by Danielssen and Koren as *Ph. eremita* (Sars). These differences are (1) the slightly smaller size of the specimens in the National Museum, none of which is more than 25 or 30 mm. in total length, including a slight allowance for contraction, although it is quite possible that the living animal may measure 20 to 50 mm., which Selenka (1883) gives as the length of *Ph. eremita*. (2) The introvert in the specimens from off the New England coast is shorter than the trunk (pl. 58, fig. 4), whereas in *Ph. eremita* (= *boreale*) it is said to be as long as or longer than the trunk. The dimensions given by Keferstein, however (trunk 18 mm., introvert 15 mm.), agree as to proportions with the specimens which I have examined. (3) I find no gray, yellow, or yellowish-brown pigment spots on the specimens (preserved in alcohol) that I have examined, such as have been found in this species.

The skin is usually dark grayish- or yellowish-brown and, in some specimens, has a slight iridescence. The most constant and striking characteristic of the skin is the occurrence of parallel transverse ridges and furrows (pl. 58, fig. 4) which everywhere encircle the body, but are especially constant at the posterior extremity, which in some cases is raised into a knob-shaped elevation surrounded by concentric ridges. In many individuals the transverse ridges are broken, particularly at the posterior extremity of the body and at the base of the introvert, by less prominent longitudinal ridges.

Very minute, finger-shaped papillæ (in many specimens darker than the rest of the skin, and hence easily visible with a lens) are scattered somewhat sparsely, but rather evenly, over the surface. The papillæ are somewhat more abundant, however, at the base of the introvert and near the posterior extremity of the trunk than elsewhere. They are found upon the ridges and, at the posterior end of the body, upon the squarish blocks of skin into which the ridges are broken. The skin and body wall are thick and tough in most individuals.

Digitized by Google

There are 22–24 simple tentacles in the specimens which I have examined, produced by the slight modification of a tentacular fold. Théel (1905) finds, among the many specimens from the northern and Arctic regions that he has examined, from 16 to 40 tentacles. Each has the usual longitudinal furrow on the oral surface. A simple nuchal organ consisting of a pair of elevations lies in the mid-dorsal interruption of the tentacles.

The longitudinal muscles form a continuous layer. The two retractors (fig. 1) have their origin in the middle third of the body. A pair of prominent gonads were found attached to their bases. The nephridia are small and hang free. The brain is not distinctly bi-lobed, and is without visible eye-spots. There is a well-marked cerebral organ. The alimentary tube has numerous coils. The esophagus is attached to each of the retractor muscles by a peritoneal membrane containing muscle fibers. The intestinal coil hangs free behind, but is held at the anterior end by two muscle strands, one attached to the junction between the esophagus and descending spire, united to the body wall on the left; and one attached to the third coil and to the right side of the body wall. There is no spindle muscle, but a transverse sheet of muscle holds the short rectum to the wall of the body. There is a simple Polian tube.

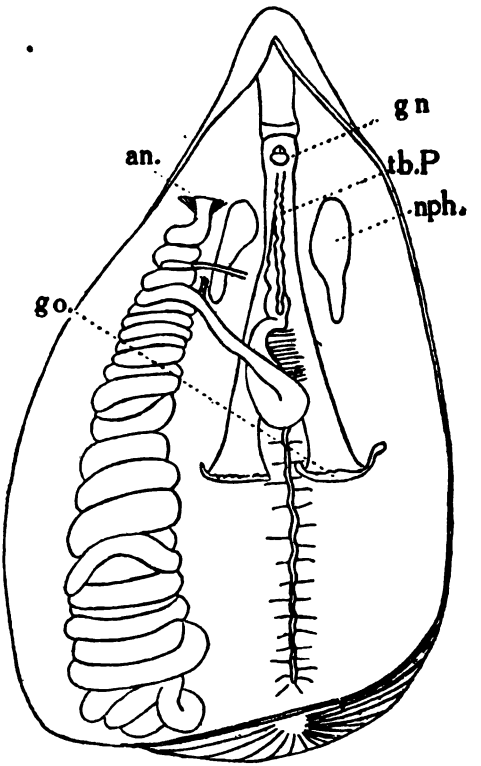


FIG. 1.—DISSECTION SHOWING INTERNAL STRUCTURE OF PHASCOLOSOMA EREMITA. × 4, *an*, ANUS; *gn*, CEREBRAL GANGLION; *go*, REPRODUCTIVE ORGANS; *nph*, NEPHRIDIUM; *tb. P*, POLIAN TUBULE.

PHASCOLOSOMA EREMITA (Sars) var. SCABRA, new variety.

Specimens, which may be designated as representatives of a new variety, *scabra*, were dredged with *Phascolion strombi* and a species of *Dentalium* probably off Cashes Ledge in the Gulf of Maine in 1873. The shape of the contracted specimens indicates that they may have been taken, like the Phascolions, from cast mollusk shells.

Type.—Cat. No. 8396, U.S.N.M.

Digitized by Google

They differ from the typical form in that the circular ridges and furrows of the external surface are nearly concealed by the loose, thick, coffee-colored cuticula, which gives the surface the appearance of a rough woolen fabric. In one of these specimens the brain is distinctly bilobed, and the nephridia are long, but there are no constant internal peculiarities that I can discover.

Specimens from Casco Bay have a similar, though less marked, scabrous appearance, and certain individuals from off Cape Ann show the same tendency.

VARIATIONS FROM GREAT DEPTHS.

The single specimen taken at station 2052, south of Georges Bank, 1,095 fathoms, differs markedly in external appearance from the typical form. It has a thick, rough, grayish integument thickly covered at the posterior extremity of the trunk with bluntly rounded papillæ.

The imperfect specimen from station 891, south of Marthas Vineyard, 480 fathoms, on the other hand, has a smooth, thin skin suggesting that of *Ph. margaritaceum*.

PHASCOLOSOMA VERRILLII Gerould.[1]

Station 15, south of Naushon Island, Massachusetts, 7½ fathoms, rocks and sand. One specimen.

Station 79, north of Nashawena Island, 5½ fathoms, mud. One specimen.

Station 93, off north shore of Naushon, 7–8 fathoms, sandy mud. One specimen.

Station 135, mouth of West Falmouth Harbor, 3¾–5 fathoms, sand and pebbles. Two specimens.

Station 7811, off West Falmouth, Massachusetts, 6¾ fathoms. Three specimens.

Station 1188 (year 1884), off Nobska Point, 4½–5 fathoms, hard sand.

Off Tarpaulin Cove (south of Naushon).

Station 2280 (1884), off Cape Hatteras, lat. 35° 21′ N.; long. 75° 21′ 30″ W., 16 fathoms, gray sand and broken shells. Six specimens.

This species occurs in the shallow waters of Vineyard Sound and Buzzards Bay, Massachusetts, and extends southward as far at least as Cape Hatteras, and probably farther. The biological survey of the Woods Hole region carried on by Dr. F. B. Sumner in 1905 and 1906 brought to light eight specimens, and four others from Vineyard Sound and six from off Cape Hatteras had already been preserved in the U. S. National Museum. I secured one specimen off West Falmouth in August, 1907, by dredging with the *Phalarope*,

[1] Science, vol. 27, No. 691, March 27, 1908.

Digitized by Google

but several hauls made for this purpose in the same locality with the larger apparatus of the *Fish Hawk* were unsuccessful.

The depth at which it has been taken varied from 3¾ to 8 fathoms about Woods Hole, and was 16 fathoms off Cape Hatteras. It occurs either in sand or mud, or a combination of the two.

The largest specimens that I have examined have a total length of 25 mm., of which the trunk is 15 mm., the introvert about 10 mm. (pl. 58, fig. 5). The somewhat thick, cylindrical trunk (thickness one-tenth to one-fifth of the length) tapers rapidly to a blunt end behind. The slender cylindrical introvert has a uniform diameter except at the base, where it expands slightly as it joins the trunk. Its diameter is less than half that of the trunk (as, for instance. 1 mm. to 2.5 mm. in a specimen with a total length of 25 mm.).

There is a single row of 34 tentacles, or less. A young individual, 7 or 8 mm. in length, has 12. There are no hooks on the introvert.

This species has the peculiar possibility, under adverse conditions, of withdrawing the introvert from the thick cuticula which covers it. The cuticula is first loosened, and then sloughed off, but retained as a tubular, or trumpet-shaped, protuberance from the anterior end of the body, like the proboscis of an echiurid (pl. 59, fig. 7). This malformation does not prevent the alternate introversion and extension of the anterior end of the animal, though the anterior extremity of the introvert with the tentacles can not be completely expanded. This peculiar result of unfavorable circumstances appeared in both of the living specimens that I examined, the first being in that condition when taken from the dredge, the second assuming it after an attempt had been made to stupefy the animal with weak alcohol.

The color varies from dark-seal brown, or dark-steel gray with iridescent tints and dark-brown papillæ, to light brown, or more exactly café-au-lait. The color probably depends upon the nature of the bottom. The seal-brown specimens were taken from a sandy or pebbly bottom; the iridescent steel-gray specimen from sandy mud, and the light-brown specimen from mud. Ripe males, if not too deeply pigmented, are easily distinguished from the females by the white color of the sperm shining through the translucent walls of the body.

Both trunk and introvert are covered with prominent papillæ of a darker hue than the rest of the skin (pl. 58, fig. 5). They are largest and most crowded at the posterior end of the trunk and at the base of the introvert, smallest and least abundant in a broad zone in the middle of the trunk, and gradually increase in size and abundance from this zone backward to the posterior extremity. Likewise on the introvert the papillæ decrease gradually in size and abundance from the base to the region immediately behind the tentacles, which are nearly devoid of papillæ. The large papillæ on the base of the intro-

Digitized by Google

vert and at the posterior end of the trunk are finger-shaped, or bluntly conical, and attached to the body by a small neck. On the introvert of a large individual they measure 0.08 mm. or 0.09 mm. in length and 0.033 mm. to 0.038 mm. in breadth, but on another specimen they are from 0.04 mm. to 0.05 mm. long and about 0.03 mm. in thickness. In the middle of the trunk the larger papillæ are ovate and fungiform, about 0.04 mm. in diameter. Smaller, undeveloped papillæ are interspersed among the others.

The two (ventral) retractor muscles (fig. 2) arise from the body wall in the adult slightly in front of the middle of the trunk. In a very young individual (7 mm.–8 mm. in length) they were found to arise at the posterior end of the second third. The relative position of the attachments of these muscles evidently shifts forward in this form, as in other sipunculids, during the postlarval life, owing to excessive growth of the body wall at the posterior pole. (See Gerould, 1906, p. 119.)

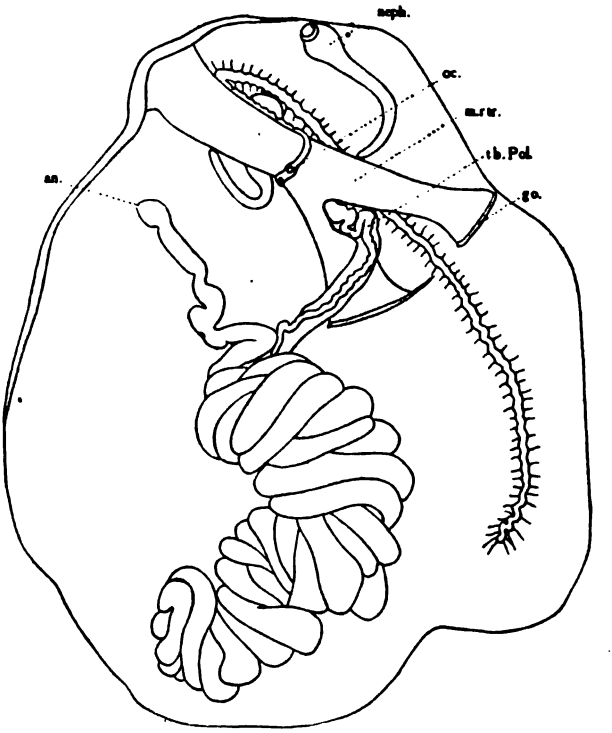


FIG. 2.—DISSECTION OF PHASCOLOSOMA VERRILLII. × 9. *an*, ANUS; *go*, REPRODUCTIVE ORGANS; *m.rtr*, RETRACTOR MUSCLE; *neph*, NEPHRIDIUM; *oc*, PIGMENTED EYE; *tb. Pol*, POLIAN TUBULE.

The pair of large nephridia are situated nearly opposite the anus, but slightly in front of it. A prominent ciliated nephrostome opens into the ventral side of the base of the nephridium. Its circular orifice communicates with a narrower passage which runs backward close to the ventral wall of the nephridium and parallel to the latter into the cavity of the nephridium, from which a septum partially separates it. The length of the passage is three or four times the width of the orifice.

The supraesophagal ganglion of the adult is oval, or spindle-shaped, with its chief axis transverse to the length of the body. A

Digitized by Google

pair of prominent pigmented eyes lie within the brain near its anterior, dorsal, and lateral surfaces. They consist of the pigmented posterior extremities of a pair of slender, cylindrical ocular tubes, which run forward to the lateral surfaces of an oval epidermal protuberance in front of the brain, the cerebral organ. This organ lies dorsal to the buccal region and anterior to the ciliated nuchal organ. The ocular tubes are filled with a transparent, homogeneous material (fluid or semifluid) which does not readily stain, in the midst of which lies a long, spindle-shaped, refractive cone, which stains readily with fuchsin. Its chief axis coincides with that of the tube.

The intestine consists of about 26 whorls. It is of wide caliber, and terminates in a long, straight rectum. A large simple Polian vessel runs the length of the esophagus upon its dorsal side.

Phascolosoma verrillii, which has a southern range, resembles *Ph. pellucidum* Keferstein (=*Ph. riiseii* Keferstein) in its proportions, in internal structure, including the presence of pigmented eye-spots, but the skin is not so thin as in the latter, and the papillæ are perhaps not so slender and spine-like. *Ph. pellucidum* from St. Thomas (Antilles) measures, according to Keferstein, trunk 45 mm., introvert 23 mm.; the hookless individuals which Keferstein calls *Ph. riiseii* measure, trunk 40 mm. and introvert 20 mm., so that this species is more than twice as long as *Ph. verrillii*.

Professor Verrill (1873) mentions this form in his Report on the Invertebrate Animals of Vineyard Sound, page 333 [627] as "A species similar to the last [*Ph. cæmentarium*] in size and form, with a thick integument, thickly covered throughout with small rounded papillæ or granules, but without the dark chitinous hooks seen on the posterior part of the latter." He possibly refers to it again on page 59 [353] under the "Fauna of the sandy shores of the bays and sounds." It appears to have been found with *Ph. gouldii* in the sand at low water, evidently by digging. Again on page 122 [416] it is mentioned as occurring with *Ph. cæmentarium* on gravelly and shelly bottoms.

Since Professor Verrill thus briefly described this species it is appropriately known as *Ph. verrillii*, in recognition of the large contributions to science of this veteran naturalist and distinguished pioneer of American zoology.

PHASCOLOSOMA FLAGRIFERUM Selenka.

Station 2566, latitude of Cape Charles, Virginia, 37° 23′ N.; long. 68° 08′ W.; 2,620 fathoms; bottom temperature, 36.4°; gray ooze. Two specimens.

Previous records:

Selenka (1885), *Challenger*, station 44, lat. 37° 25′ N.; long. 71° 40′ W.; 1,700 fathoms; bottom temperature, 36.2°; blue mud; also from the Pacific Ocean, *Challenger* station 241, lat. 35° 41′ N.; long. 157° 42′ E.; 2,300 fathoms; bottom temperature, 35.1°; red clay.

Digitized by Google

Sluiter (1900), station 757, off Cape Finisterre, Spain, lat. 44° 06′ N.; long. 12° 41′ W.; 4,900 meters; clay mud.

Two specimens were taken by the Fisheries steamer *Albatross* in 1885 with a trawl in the same region at which the *Challenger* took a specimen in 1873—that is, east of Cape Charles, Virginia, and southward from Cape Cod. Another specimen was dredged by the Prince of Monaco off Cape Finisterre, Spain, and two specimens by the *Challenger* from the Pacific Ocean, east of Japan. It is found in the deep sea at a depth of 1,700 to 2,678 fathoms.

The posterior end of the elongated trunk is prolonged into a slender flagellum.[1] Flat, oval papillæ projecting forward, a half millimeter long, are found near the posterior extremity of the trunk, which elsewhere appears smooth. Slender, finger-shaped papillæ are found upon the introvert. There are no hooks.

The trunk of the specimen that is intact measures about 60 mm., the introvert about 40 mm. Selenka's largest specimen was 130 mm. in total length; Sluiter's, with largely retracted introvert, 120 mm. The color of the trunk is yellowish-brown, with pigment at the anterior extremity, which probably gives the bluish color in that region noted by Sluiter. The slender, thin-walled introvert is of a lighter color. The anus is prominent, and the openings of the nephridia are situated slightly in front of it, opposite each other. Selenka describes a circlet of finger-shaped tentacles, which are heart-shaped in cross section.

The coils of the intestine are numerous. It is free behind, but a spindle muscle holds it in front (Selenka). The nephridia are free. There is a simple contractile tube.

PHASCOLOSOMA SABELLARIÆ Théel.

[–PHASCOLOSOMA (PETALOSTOMA) MINUTUM Keferstein?].

A large number of these minute, transparent sipunculids were taken by the Fisheries steamer *Albatross* in 1883 from station 2084, south of Georges Bank, lat. 40° 16′ 50″ N.; long. 67° 05′ 15″ W., in 1,290 fathoms, where the bottom is of gray mud and sand and the temperature 40° F. One specimen was also taken from each of the following stations in the same general locality: Station 1095, lat. 39° 55′ 28″ N.; long. 69° 47′ W.; 321 fathoms soft green mud; temperature at bottom, 40° F.; station 2571, lat 40° 09′ 30″ N.; long. 67° 09′ W.; 1,356 fathoms, gray Globigerina ooze; temperature at bottom, 37.8° F; and two from off Chatham, Massachusetts, station 372, lat. 41° 40′ N.; long. 69° 28½′ W., in 70 fathoms and from a sandy bottom.

The largest specimens measure in contracted conditions about 8 mm. in total length, that of the trunk being 5–6 mm., and the introvert may be estimated as being nearly as long as the trunk. In

[1] For figures see Selenka (1885), pl. 3, fig. 17, and Sluiter (1900), pl. 1, fig. 3.

Digitized by Google

Théel's description the total length of the largest specimen (expanded) is 15 mm., proboscis more than one-third of the total length. The introvert is slender and cylindrical, and is marked off from the trunk in certain of the American specimens by a slight dorsal hump on which the anus is situated, or by an annular elevation about that region, though some specimens do not show these features. The skin is smooth, except that a few minute epidermal organs are found at the base of the introvert and at the posterior extremity of the trunk (fig. 3). The epidermal organs consist of a crater-like ring of four or five cells rising slightly above the surface, surrounding a minute,

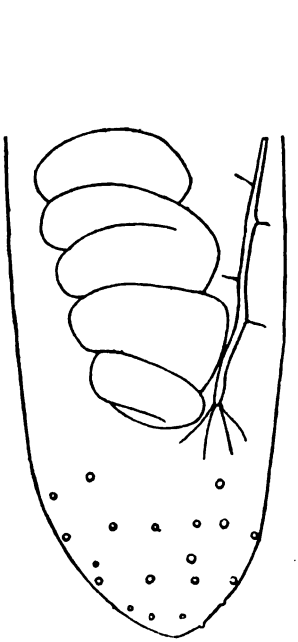


FIG. 3.—POSTERIOR EXTREMITY OF PHASCOLOSOMA SABELLARIÆ SHOWING PAPILLÆ.

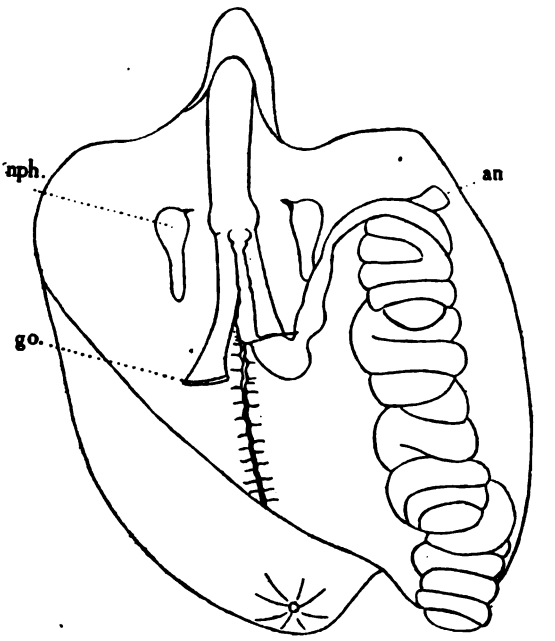


FIG. 4.—DISSECTION OF PHASCOLOSOMA SABELLARIÆ. × 13½. *an*, ANUS; *go*, REPRODUCTIVE ORGAN; *nph*, NEPHRIDIUM.

slender, transparent cuticular elevation. The body wall is thin and transparent.

Théel states that the tentacles are represented by irregular, rounded prominences of the oral disk, and that hooks are absent, though he found in rare cases (1 per cent) a few small ones.

The two ventral retractor muscles (fig. 4) are attached slightly behind the middle of the trunk, the pair of nephridia suspended nearly opposite the anus. They hang free, and are easily broken off in dissection. There are no eye spots. The nerve cord terminates slightly in front of the posterior end of the body, and a pair of nerves runs backward between the circular and longitudinal muscles.

Digitized by Google

The esophagus is long, the rectum rather short; the intestinal coil, which is free behind, consists of about 13 double turns (Théel, 1905), and extends backward to the posterior end of the cœlom. The esophagus is held to the retractors by a few muscle strands, but no supporting fibers were elsewhere observed. (Théel's fig. 175 shows the supporting fiber of the esophagus attached to the body wall rather than to the retractor.) Théel states that the parts of the retractors that have united anteriorly are always longer than their remaining separate portions, and the same is apparently true of the American specimens, though Paul (1909) shows that in a specimen from the coast of Sweden, which he sectioned transversely, the fusion occurs through about the middle fifth only, the muscles of the anterior two-fifths being separate.

The sexes in the specimens that I have examined from off the American coast appear to be separate, the males when full of sperm being whitish, and easily distinguished from the females. Some males contain immature sperm in oval or pear-shaped masses, which viewed with a hand lens might be mistaken for eggs. The body cavity of the female contains relatively few large, opaque eggs. In no case do I find any evidence of hermaphroditism.

Théel found no males of this species, though he considered it possible that the papillate *Ph. improvisum* Théel which was taken at the same locality might be the male. Paul (1909), comparing *Ph. sabellariæ* with *Phascolosoma* (*Petalostoma*) *minutum* Keferstein from the coast of France, arrives at the conclusion that both are of the same species and both hermaphrodites. The evidence which he presents on both of these points, however, is not entirely satisfactory, and especially is this true of the supposed hermaphroditism of *Ph. sabellariæ*. His figures of the reproductive organ of *Ph. minutum* in section (figs. 5 and 21) have the appearance of a typical ovary, though containing groups of cells supposed from their size and the density of their chromatic contents to be spermatocytes. In sections of the ovary of *Ph. gouldii*, I find clusters of small cells of a similar appearance beneath the peripheral oocytes, but, though I have examined the cœlomic fluid of hundreds of individuals of both sexes in this species, in no case have I ever found both ova and sperm in the same individual. Paul, in referring to the ovaries of *Ph. sabellariæ*, makes this statement bearing on the question of sex (p. 30): "Doch finden sich auch die Zellengruppen wieder, die Ich bei Petalostoma minutum als vermuthlich männliche bezeichnet habe. Die verschiedenen Entwicklungsstadien von beiderlei Geschlechtszellen treiben genau so in der Leibeshöhle umher, wie bei Petalostoma minutum beschrieben wurde." Professor Spengel, likewise, in whose Institut Paul's work was done, writes me that *Ph. sabellariæ* and *Ph. improvisum* are at least extraordinarily like *Ph. minutum*, and that he is quite certain of

Digitized by Google

the hermaphroditism of *minutum*, in reference to which he says: "Paul hat sicher neben den Eiern immer Spermien und ihre Bildungsstadien angetroffen, wie er es beschrieben hat, und das auch bei ein und demselben Individuum von *Ph. sabellariæ* Théel."

In view of such trustworthy testimony I have made a renewed search for evidences of hermaphroditism in the specimens from station 2084, but the examination of three males full of sperm and of several females containing oocytes gives only negative results, though it does not of course exclude the possibility of hermaphroditism if we assume, as Paul does, that an individual may successively produce ova and thereafter sperm.

If further investigation should show that these forms from European waters are identical and hermaphroditic, and that the one just described from the American coast is diœcious, it may be necessary to give the latter a new name; in which case I would suggest *Phascolosoma diaphanes*, new species. In other respects the American form closely resembles the form described as *Ph. sabellariæ* Théel, and varies only slightly (in the thinness of the body wall) from the earlier described *Phascolosoma* (*Petalostoma*) *minutum* Keferstein.

PHASCOLOSOMA IMPROVISUM Théel.

[=PHASCOLOSOMA (PETALOSTOMA) MINUTUM Keferstein?].

Under this name Théel (1905) described a form with distinct papillæ on the posterior end of the trunk and on the introvert, and a girdle of hooks behind the short, rounded tentacles. Otherwise this type appears to be identical with *Ph. sabellariæ* Théel, and Paul (1909) regards both forms as identical with *Petalostoma minutum* Keferstein. However this may be, I shall tentatively apply the name to certain small sipunculids in the United States National Musuem from the following localities:

Station 2234, lat. 39° 09′ N.; long. 72° 03′ 15″ W. (east of New Jersey) in green mud, from 810 fathoms; temperature at bottom, 38.6° F. One specimen.

Station 549, off Niantic Bay, Connecticut, from a sandy bottom, 5 fathoms. Twelve specimens.

Thus it appears that this form lives in shallow water near the shore, as is the case in Sweden, but it also is found at a long distance from shore and at a depth of 810 fathoms. In these respects it resembles the closely allied or identical form *Ph. sabellariæ* Théel in this country, which in Sweden has been found only near the shore with *Ph. improvisum*.

The largest specimen was the one taken from the off-shore station, the trunk of which measures 10 mm. The largest specimen from Niantic Bay has a total length of 13 mm. (introvert 5 mm., trunk 8 mm.). Another has an introvert of 3 mm., a trunk of 4.5 mm.

Digitized by Google

The surface of the skin is smooth, with prominent papillæ at the posterior end of the trunk. Those elsewhere are exceedingly small, and on the anterior part of the trunk they are reduced in number and size almost to the vanishing point, though minute papillæ similar in size to those on the middle zone of the trunk are uniformly distributed over the introvert.

In certain preserved specimens, like the one taken at station 2234, local contraction of the integument at the posterior and anterior ends of the trunk produces the erroneous impression of permanent shields, as in *Aspidosiphon*.

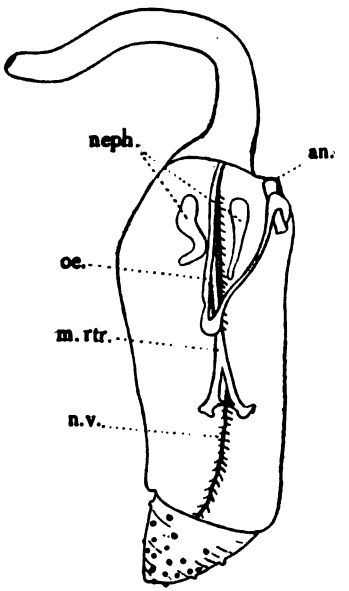


FIG. 5.—DISSECTION OF PHASCOLOSOMA IMPROVISUM FROM OFF NIANTIC BAY, CONNECTICUT, IN FIVE FATHOMS, STATION 549. INTESTINAL COIL NOT SHOWN. × 12½. *an*, ANUS; *m. rtr*, RETRACTOR MUSCLE; *neph*, NEPHRIDIUM; *n. v*, VENTRAL NERVE CORD; *œ*, ESOPHAGUS.

The two retractor muscles (fig. 5) are attached to the body wall not far from the middle of the length of the trunk, but there appears to be a good deal of variation in this respect, as Théel has also found. They are joined together near their posterior attachments to form one. In one of the two specimens dissected, the posterior extremities of the two retractors were bound together by a transverse muscular cord.

The long esophagus lies dorsal to the united retractor muscle, and passes into a many-coiled intestine which joins a short rectum.

The short, cylindrical nephridia taper slightly, and are attached to the body immediately behind the zone in which the anus lies.

So far as I have examined these few specimens I have found none with eggs, which was also the condition which Théel found in the Swedish specimens, and which led him to suppose that this might be the male of *Ph. sabellariæ*. The American specimens of the male of the latter species, however, as I have already stated, are smooth, whitish individuals easily distinguishable from this papillate, slightly more opaque form.

PHASCOLOSOMA CINEREUM, new species.

A specimen was taken from south of Key West (station 2317), lat. 24° 25′ 45″ N.; long. 81° 46′ 45″ W., at a depth of 45 fathoms and from a bottom of coral sand and temperature of 75° F. The contracted trunk is 14 mm. long, 7 mm. thick. Introvert very short, 4 or 5 mm. in length.

Type.—Cat. No. 4087, U.S.N.M.

Digitized by Google

Color ashen gray; introvert of a lighter shade; trunk covered with minute brown papillæ, which at the posterior end of the body are long and finger-shaped, ovate with a slender stalk (fungiform) in the middle of the trunk, and bluntly conical at the anterior extremity. Those of the introvert are much finer and cylindrical. A narrow zone of minute, dark-colored, irregularly placed hooks (fig. 6) lies immediately behind the tentacles. Body wall tough and opaque. The cuticula, which resembles that of *Ph. procerum*, is thrown up into sinuous longitudinal folds near the posterior end of the trunk.

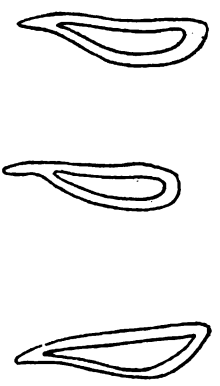


FIG. 6.—HOOKS FROM INTROVERT OF PHASCOLOSOMA CINEREUM. × 290.

The inner surface of the body wall is smooth and lustrous, of a violet-brown color. A single pair of strong, completely separate ventral retractor muscles (fig. 7) are attached to about the middle of the trunk. The pair of nephridia hang free from the body wall opposite the anus. The contractile tube is without cæca. The esophagus is held by fine muscle strands to the retractors. There are about 15 whorls in the intestinal coil, which is held by a muscle

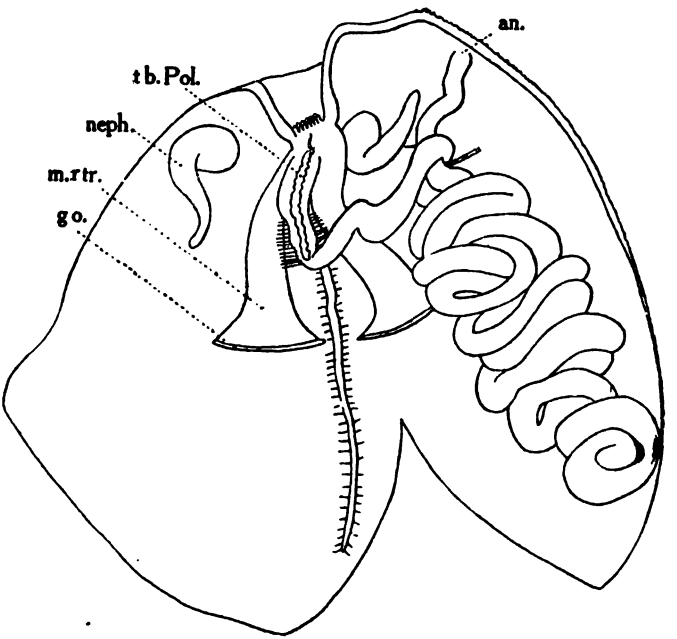


FIG. 7.—DISSECTION OF PHASCOLOSOMA CINEREUM. × 5¼. *an*, ANUS; *go*, REPRODUCTIVE ORGANS; *m. rtr*, RETRACTOR; *neph*, NEPHRIDIUM; *tb. Pol*, POLIAN TUBULE.

strand on each side of the first turn, but free behind. The rectum is short. There are no eye-spots.

Digitized by Google

This species most nearly resembles *Ph. coriaceum* described by Keferstein (1865) as occurring also among the West Indies, at St. Thomas. *Ph. cinereum* is similar to *Ph. coriaceum* in the size and proportions of the trunk and introvert, in the retractor muscles, and in the general appearance of the papillæ, but it differs from this species in several respects: The hooks of *Ph. cinereum* are slenderer, and are restricted to a narrow zone immediately behind the tentacles, not widely scattered over the anterior half of the introvert; the tentacles are probably less numerous and larger, though the single contracted specimen at hand does not permit an accurate comparison; the papillæ at the posterior extremity of the body are not fungiform, as represented in *Ph. coriaceum* by Selenka (1883, pl. 5, fig. 53), but long and finger-shaped; the color is gray, not yellowish-brown (Selenka, pl. 1, fig. 15); the contractile tube is simple, without cæca which give it a tufted appearance in *Ph. coriaceum*; the rectum of *Ph. cinereum* is short, not longer than the intestinal coil as in *Ph. coriaceum*.

PHASCOLOSOMA CINCTUM, new species.

Station 994, lat. 39° 40′ N.: long. 71° 30′ W.; 368 fathoms, mud; temperature at bottom, 40.5° F. Type.

Station 2084, lat. 40° 16′ 50″ N.; long. 67° 05′ 15″ W.; 1,290 fathoms, blue mud and sand; temperature at bottom, 40° F.

Type.—Cat. No. 8328, U.S.N.M.

Chief characteristics.—Two weak retractor muscles. Introvert about one-half the length of the trunk, when both are expanded. Coarse, isolated, circular muscle fibers are prominent, especially in the introvert, which is marked off obliquely and sharply from the trunk. A zone of fine recurved hooks around the introvert, immediately behind the head. Prominent papillæ near the posterior end of the trunk. Inhabits empty tubes of *Hyalinœcia*.

The two specimens of this remarkable sipunculid (pl. 59, fig. 6) were taken off Marthas Vineyard at the above-mentioned stations. At the former *Ph. procerum* also occurs; at the latter a large number of specimens of *Ph. sabellariæ* Théel were found. The larger of the two specimens is partially inclosed in a fragment of a *Hyalinœcia* tube, which fits closely about the body.

The total length of the specimen from station 994, which was evidently stretched out in its tube when it died, is 30.5 mm., of which the introvert is 6 mm. or about one-fifth the length of the trunk. The other specimen, the introvert of which is perhaps fully expanded, measures about 13 mm., of which the introvert is 6 mm., the trunk 7 mm. It is probable that the trunk of the latter specimen is much contracted, as is the introvert of the former.

The slender, cylindrical introvert is united to the thicker trunk by an oblique line of junction extending from the region of the anus

Digitized by Google

ventrad and cephalad (pl. 59, fig. 6). About three rows of delicate, recurved hooks lie in the zone immediately behind the tentacles. The wall of the introvert is thinner and more translucent than that of the trunk. The circular muscle fibers in this region are coarse and so prominent as to cause in certain places slight circular elevations of the epidermis. They are separated from one another by rather wide intervals, whereas the underlying longitudinal muscle fibers, which are much finer than the circular fibers, form a continuous layer. The action of the strong, isolated circular muscle fibers is evident in the trunk by numerous constrictions that occur in the extended specimen and by the tendency of the body wall to become torn transversely. Parallel longitudinal ridges appear prominently in the epidermis of the contracted trunk.

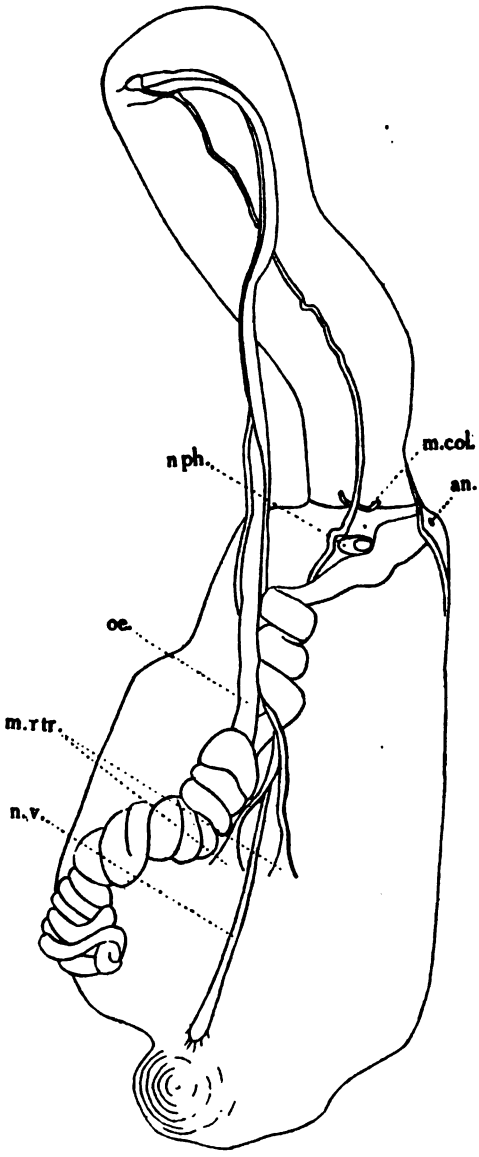


FIG. 8.—DISSECTION OF PHASCOLOSOMA CINCTUM, STATION 2084. × 13½. *an*, ANUS; *m. col*, COLLAR MUSCLE; *m. rtr*, RETRACTOR MUSCLE; *nph*, NEPHRIDIUM; *n. v*, VENTRAL NERVE CORD; *œ*, ESOPHAGUS.

Conspicuous oval papillæ occur near the posterior extremity. At the extreme tip of the body, however, the papillæ are exceedingly small, gradually but rapidly increasing to the maximum size from behind forward. Inconspicuous papillæ are scattered over the entire trunk and introvert. They are largest and most numerous immediately behind the base of the introvert, and exceedingly small in the middle of the trunk and upon the introvert.

The two specimens differ in color. That which occurs with *Ph. procerum* is, like that species, gray; the other is grayish-brown, but

Digitized by Google

the posterior extremity and papillæ of that region are yellowish brown.

The longitudinal muscles of the body wall consist in the trunk, as in the introvert, of exceedingly fine fibers that form a continuous layer. The single pair of somewhat slender, dark brown retractors (fig. 8) are attached in the posterior half of the body, slightly behind the middle of the trunk and, in the specimen examined, approximately three-fourths of the distance from the head to the posterior end of the body. In the trunk they are cylindrical and extremely slender, but are expanded into a flat fan shape at their posterior attachment. In the introvert they closely ensheathe the narrow esophagus. In the specimen dissected one was twisted sharply about the other in the region where the rectum joins the esophagus. At the base of the introvert a narrow slip of circular muscle fibers extends into the body cavity from the body wall ventral to the nerve cord, and encircles not only the nerve cord but also the esophagus and the retractor muscles. It serves as a muscular collar, holding in position the long retractor muscles, which are everywhere else free except at their terminal points of attachment.

The nephridia (fig. 8) are short and slipper-shaped with a wide nephrostome, and are situated nearly opposite, but slightly behind, the anus. Only the right one was seen. The nerve cord is a flat band. The long esophagus joins an intestine of about 16 coils.

Genus PHASCOLION Théel.

This genus is composed of small sipunculids showing a marked asymmetry in the development of the nephridia and reproductive organs and often a spirally twisted body, adaptations to life in empty shells of gasteropods and scaphopods. They also live in the tubes of annelids or in those of their own construction. There is a single row of tentacles around the mouth, and numerous recurved hooks often occur in a zone behind the tentacles. In most species numerous attaching papillæ or holdfasts, each capped with a chitinous denticle projecting forward, occur in a broad band encircling the body near its posterior end. Only one nephridium is developed, and it lies posterior to the anus. The intestine is not thrown into spirals, but into loops extending forward and backward and held to the body wall by several strands of muscle fiber. One or two retractor muscles are found; in the latter case the dorsal in most species is larger than the ventral.

The Phascolions of our coast have the characteristic holdfasts upon the posterior half of the trunk, each capped with a sharp arrowhead-shaped or crescentic chitinous denticle. Only the right nephridium is developed, and the gonad is unsymmetrically situated, curving around the right side of the origin of the ventral retractor muscle, near the posterior end of the body. The ventral retractor

Digitized by Google

being attached to the body wall by two roots, the gonad crosses the right root.

The intestine has six characteristic loops, the first, third, and fifth extending forward, the second, fourth, and sixth backward; the fifth hangs free, but the others are bound to the body wall by muscle strands.

The opinion advanced by Selenka (1883) that the various species of *Phascolion* have arisen from *Phascolosoma* appears to be well founded. Such a change would have involved the almost complete fusion of the two dorsal and likewise of the two ventral retractor muscles to form in each case one. Selenka also expressed the belief that *Phascolion* has arisen by several distinct stems. However that may be, the individuals of the North American coast form a fairly homogeneous, though variable, group.

With the possible exception of *Phascolion alberti* Sluiter, all of these eastern forms will be most satisfactorily considered as forming a single species, formerly known as *Ph. cæmentarium* (Quatrefages), but which is identical with the widespread *Ph. strombi* of Europe, as I have determined by comparing specimens from the west coast of Sweden with those from the eastern coast of North America.

Ph. strombi in America, as elsewhere, shows a remarkable variability in size, color, thickness of the body wall, size of the papillæ and holdfasts, and hence in the smoothness or roughness of the skin. The internal organization is more stable, though the eggs vary in shape, in the thickness of the yolk membrane and in the amount of yolk. In certain localities off Halifax the dorsal retractor shows a tendency to a division at the base into two roots, but this in no region is a constant character.

The extraordinary plasticity of the external characteristics of *Ph. strombi* make it a favorable animal upon which to study experimentally the effect of the environment upon form. According to Théel (1875), moreover, it is remarkably tenacious of life, and is readily kept alive for more than a month in ordinary aquaria, so that it would no doubt live well under such modification of external conditions as such experiments would demand.

A study of the very large number of specimens of this species in the U. S. National Museum has convinced me that the most striking variations in the external features are due in large measure to the environment. Thus the introvert is relatively short in individuals that have adapted themselves to the narrow tubes of *Protula*, *Hyalinæcia*, or *Pectinaria*, in comparison with the trunk which is greatly elongated by compression within the slender tube. Such individuals also have a smooth and often lustrous skin, especially in the region of the holdfast near the posterior end of the body. Furthermore, they show no external signs of a spiral twist, whereas those which

Digitized by Google

inhabit the cast shells of gasteropods are twisted. The latter have the posterior extremity of the body made smooth by the compression within the apical whorl of the shell, the holdfasts are small, the skin is thin and white. On the other hand, those which live in cement tubes constructed by chætopods or by themselves have prominent papillæ at the posterior end, strong, sharp holdfasts, and a thick, colored skin. Many such comparisons readily occur to one who has examined a large number of specimens of the varieties presently to be described.

Little is known of the development of *Phascolion*. It would be of much interest to learn whether the asymmetry of the adult is manifest in the youngest larvæ by the appearance of a single nephridium, viz, the right, or whether the primordium of the left nephridium appears and subsequently becomes atrophied.[1] Are the retractor muscles of the larva paired or single? The answer to this question might perhaps furnish evidence in favor of the supposed origin of *Phascolion* from an ancestral *Phascolosoma* with paired retractors. In the larva of *Phascolosoma* these muscles are distinctly paired.

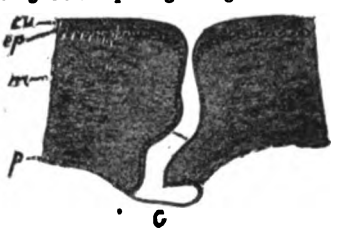


FIG. 1.—AFTER MOLTCHANOFF. TRANSVERSE SECTION OF THE ATROPHIED LEFT NEPHRIDIUM OF PHASCOLION. *c*, BODY CAVITY; *cu*, CUTICULA; *ep*, EPIDERMIS; *m*, MUSCULAR LAYER; *p*, PERITONEUM. (Oc. 1, Syst. 6, Leitz.)

[1] This question has been partially answered by L. A. Moltchanoff, 1909, in Bull. Acad. Sci., St. Petersbourg, ser. 6, vol. 3, pp. 69–74, 5 figs., who shows that in *Ph. spitsbergense* Théel, which Théel later identified as a form of *Phascolion strombi* (Montagu), the left nephridium is represented in the adult by a vestigial canal passing through the wall of the body. Moltchanoff's statement translated into English is as follows: "The left nephridium is not completely absent. Sections show clearly that there exists on the left, symmetrically with the well-developed nephridium, a small canal, which connects the cœlom with the surrounding medium. (Fig. 1.) The structure of its walls resembles that of the corresponding portion of the well-developed right nephridium. Its internal orifice is situated upon a small elevation; it is clearly visible in examining with a hand lens the corresponding part of the dermo-muscular sac. As far as I have been able to see, it is almost completely closed by the peritoneum, but nevertheless the passage seems to exist. The function of the nephridium in question is entirely obscure, because it appears that the expulsion of the genital products takes place exclusively through the right nephridium; as for the excretory function of this canal, its rôle can not be considered as of much importance."

Moltchanoff adds that "Neither Brumpt nor Théel mentions atrophied nephridia in *Phascolion strombi* (Montagu). It would be very interesting to study sections of the corresponding region in *Phascolion strombi* to ascertain whether the canal of the atrophied nephridium shows the peculiarity of the eastern *Phascolion*, from Mourman, or, which is most probable, whether it does not exist in *Phascolion* from the west, though undescribed because it has never been seen."

I regret that this matter came to my attention too late for further investigation. It is indeed probable that this vestige of the left nephridium occurs in *Phascolion strombi* of the American coast, though I have never observed it in dissections nor examined sections through that part of the body wall where it is likely to be found.

Digitized by Google

SYNOPSIS OF SPECIES AND VARIETIES OF PHASCOLION.

- Posterior attachment of dorsal retractor usually undivided, that of ventral with two roots.
  - *Phascolion strombi* (Montagu), 16–26 tentacles.
    - Introvert longer than the trunk.
      - (*a*) Common form, orange-brown or yellowish-brown. Range from Labrador southward to 40° N. lat. . . . var. *fusca*.
      - (*b*) Dark-colored, with thick skin, sharp holdfasts. . . . . var. *tubicola*.
      - (*c*) Small, white form in gasteropod shells, common in region of Woods Hole, Mass. . . . var. *alba*.
      - (*d*) Deep-sea form with short, thin-walled trunk, large opaque, ovoid eggs . . . . . var. *hyalina*.
    - Introvert of about the same length as trunk, in shells of *Protula* and *Dentalium*. Off Cape Cod, and near the 40th parallel. Elongated, smooth; 16 tentacles. Eggs ovoid . . . . . (*e*) var. *gracilis*.
    - Introvert shorter than the trunk; dorsal retractor in some individuals is divided at the base. Blends, and probably freely interbreeds with var. *fusca* . . . . . (*f*) var. *canadensis*.
  - *Phascolion alberti* Sluiter.
    - Introvert two-thirds the length of the trunk; papillæ of anterior and middle part of the trunk provided with chitinous denticles, pointing forward. Chitinous cap of papillæ at posterior end of trunk oval. Off Newfoundland (Prince of Monaco, 1887), 1,267 meters. Off Cape Finisterre, 1,674 meters.
- Dorsal retractors, as well as ventral, probably with two roots, introvert longer than the trunk and, like the posterior end of the trunk, smooth. Constructs a tube with an additional slender sheath for the introvert.
  - *Phascolion strombi* var. *lævis*. Off coast of Massachusetts, 54 fathoms.

PHASCOLION STROMBI (Montagu).

Sipunculus strombus G. MONTAGU, Trans. Linnean Soc. London, vol. 7, 1804, pp. 74–76.

Siphunculus dentalii GRAY, Spicilegia Zoologica, London, 1828, p. 8.

Sipunculus bernhardus FORBES, A History of British Starfishes, London, 1841, pp. 251–253.

Sipunculus (*Phascolosoma*) *concharum* ÖRSTED, De regionibus marinis, Diss. phil. Haun., Hauniæ, 1844, p. 80, and Kr⁄yer's naturh. Tidskrift, p. 419.

Phascolosoma strombi DIESING, Systema Helminthum. Vindob., vol. 2, 1851, p. 65.

Phascolosomum dentalii DIESING, Systema Helminthum. Vindob., vol. 2, 1851, pp. 64–65.

Digitized by Google

Phascolosoma bernhardus POURTALÈS, Proc. Amer. Ass. Adv. Sci., Meeting of 1851, p. 41, Washington, 1851.

Sipunculus (*Cryptosomum*) *cæmentarium* QUATREFAGES, Histoire Nat. des Annélés marins et de l'eau douce, vol. 2, Paris, 1865, p. 628.

Phascolosoma hamulatum PACKARD, Mem. Boston Soc. Nat. Hist., vol. 2, 1867, p. 290.

Phascolosoma cæmentarium VERRILL, Report Invert. Animals Vineyard Sound, in First Report of the U. S. Comm. of Fish and Fisheries, Washington, 1873, p. 627, pl. 18, fig. 92; also same in separate reprint, Washington, 1874.

Phascolosoma tubicola VERRILL, Amer. Journ. Sci. and Arts, ser. 3, vol. 5, 1873, p. 99; also Proc. Amer. Ass. Adv. Sci., Meeting of 1873, pp. 388, 389, 1874.

Phascolion strombi THÉEL, Bihang till k. Svenska Vet. Akad. Handl., vol. 3, No. 3; also No. 6, pp. 13, 14, Stockholm, 1875.

Phascolion spitsbergense THÉEL, Bihang till k. Svenska Vet. Akad. Handl., vol. 3, 1875, p. 16, pl. 1, figs. 2, 3.

Sipunculus capitatus H. RATHKE, Nova Acta Acad. Leop. Car., vol. 20, 1843, pp. 143–147, pl. 6, figs. 20–23.

This abundant and widespread species is found in America from Labrador southward to the West Indies. It occurs in shallow waters of about 5 fathoms off the Elizabeth Islands, is abundant everywhere along the coast at depths varying from 20 to 150 fathoms, which naturally have been more thoroughly explored than the deeper waters, and appears to be by no means uncommon along the edge of the continental shelf in from 150 to 1,000 fathoms. The greatest depth of which I have a record is 1,061 fathoms at station 2207, just south of the fortieth parallel.

I have seen no specimens from farther south than station 2728, in 859 fathoms, north of Cape Hatteras but slightly south of the latitude of Norfolk, Virginia. Selenka (1883), however, mentions the occurrence in the West Indies of *Ph. tubicola* (Verrill), which I have ascertained to be a local variety of this species. The specimens which Selenka examined differ from the typical form in that the ventral retractor has only a single root. I have observed this same characteristic in some of the specimens from off the southern coast of the United States, though it is not by any means a constant characteristic of specimens from that region. (See "Modifications in the South," p. 415.) The ventral retractor in *Ph. strombi* in general, however, with a uniformity that is remarkable for this variable species, has two distinct roots, and the same is true of the local variety from off the New England coast which Verrill originally described as *Phascolosoma tubicola*. But the subtropical form is evidently so nearly like its more northern relatives that to exclude it from the same widespread and variable species on this ground alone would be to lay undue stress on a single characteristic of minor importance.

Phascolion strombi is common in the Arctic Ocean, occurring in abundance off the northern coast of Asia, the northern coast of Europe, Spitzbergen, Iceland, and both the eastern and western coasts of Greenland (Théel). It extends southward in Europe along

Digitized by Google

the coasts of the British Isles, France, and in the Mediterranean. It is probably the most common sipunculid throughout at least the northern part of its range, which comprises the whole of the Arctic and North Atlantic Oceans and the Mediterranean Sea.

The size of *Ph. strombi* varies greatly in different localities. The largest specimens that I have examined are from off Portsmouth, New Hampshire (station 76B, 51 fathoms), the contracted trunk of which measures 20 mm. long, 7 mm. thick, but the largest specimens from most localities have a trunk of about 15 mm.–17 mm. in length and 4 mm.–5 mm. in thickness. The slender, cylindrical introvert is longer than the trunk (fig. 9). It is impossible to determine the exact dimensions of either introvert or trunk from preserved specimens that have died in various states of contraction, and I have not had the opportunity to examine the live animals, but, judging from the numerous preserved specimens, it appears that the length of the introvert varies from a dimension only slightly greater than that of the trunk to about twice the length of the latter.

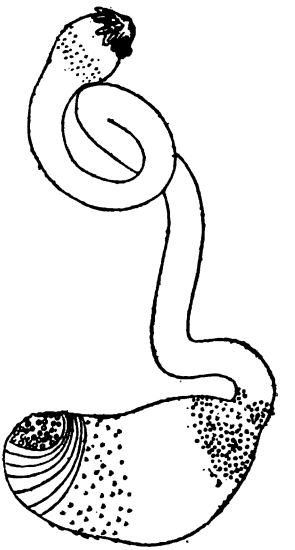


FIG. 9.—PHASCOLION STROMBI. × 4.

The white variety from the shallow waters about Woods Hole and off Block Island is much smaller.

The shape of the body depends upon that of the tubes or shells which the animals inhabit. Those which live in gasteropod shells acquire a spiral twist. On the other hand, in most localities they live in tubes of their own construction (pl. 60, fig. 10) or in deserted tubes of *Pectinaria*, *Protula*, *Hyalinæcia*, or *Dentalium*, and accordingly show only a slight tendency toward a spiral twist, visible merely in the retracted introvert.

The mouth of the cast shell or the tube inhabited by individuals of this species from off the American coast is partially closed with a hollow cone composed of a cement made of mud or fine sand, often inclosing minute pebbles, and held together by a secretion. These cones sometimes rise as much as 5 mm. above the mouth of the shell in the form of a funnel. I have found a small amount of cemented muddy sand in shells of *Dentalium* occupied by *Ph. strombi* from the west coast of Sweden, sent me through the kindness of Prof. Hj. Théel, though I judge from the fact that no mention has been made by European observers of cement formation in this species that it never is a conspicuous phenomenon in shells occupied by *Ph. strombi* in Europe, these shells being lined with loose mud or sand. It was

Digitized by Google

chiefly on the basis of this habit of cementing together the muddy sand that Quatrefages (1865) observed in specimens from North America that he gave the name *Sipunculus cæmentarius* to these specimens. The tubes of cement are usually slightly curved, and are marked on the exterior at regular intervals by annular furrows. (Pl. 60, fig. 10.)

The color of the animal varies from a very dark brown or a grayish-brown (variety *tubicola*), orange-brown or yellowish-brown (variety *fusca*) to white (variety *alba*). The dark brown specimens from certain regions have a decidedly purple hue, which is especially common in the grayish-brown individuals that live in *Pectinaria* tubes.

Light yellowish-brown or orange-brown is the color of the widely distributed typical form, as seen in specimens from Labrador, the coast of Nova Scotia, from off Eastport, off Point Judith, and farther south. The color of the local varieties will be mentioned in the descriptions that are to follow.

There are 16 tentacles (pl. 60, fig. 12) in the specimens from comparatively shallow waters off the coast of Maine and Massachusetts, but the number in other localities is 20, 24, or 26; 20 occur in specimens from off Nova Scotia (stations 44–46); 24 in individuals from 300 fathoms off Norfolk, Virginia (station 898); 26 in specimens from south of the Grand Banks of Newfoundland (station 2437). The number in two specimens figured by Théel (1904) is respectively 16 and 26, and I find 26 in a specimen from the east coast of Sweden sent to me by Professor Théel.

A zone of recurved hooks, disposed irregularly, occurs a short distance behind the tentacles (fig. 9).

Prominent papillæ cover the anterior part of the trunk and the proximal part of the introvert (pl. 60, fig. 11); elsewhere the body is provided with minute papillæ which are variable in size, abundance, and distribution in the different varieties.

The characteristic holdfasts (Haftpapillen), or papillæ crowned with triangular, arrow-shaped, chitinous hooks pointing forward, occur in a wide band (fig. 9) which extends from a little behind the middle of the trunk backward nearly to the posterior end, which in individuals that live in shells or tubes with smooth walls is smooth, or covered with minute papillæ, although specimens from tubes of cement usually have rather prominent papillæ upon the posterior extremity of the body. The holdfasts are variable in size, shape, and color; especially is this true of the varieties *gracilis* and *canadensis*. The shape of the chitinous cap is typically like an inverted U or V. The variety *alba*, which is found in gasteropod shells has U-shaped holdfasts; those of the thick-skinned variety *tubicola*, inhabitants of tubes of cement, are in general more pointed.

Digitized by Google

Internal structure.—The longitudinal muscles of the body wall form a continuous layer with a smooth, shining cœlomic surface.

The dorsal retractor (fig. 10) is large, and has its origin immediately behind that of the two roots of the ventral retractor at the posterior extremity of the body, in a single wide, flat sheet which is unsymmetrically attached to the left and dorsal sides of the body. The attachment of the left border of the muscle is close behind that of the ventral retractor, in the median plane of the body, whence the line of attachment runs dorsad across the left and dorsal sides of the body wall for a distance of slightly more than 180° of arc. The ventral retractor is attached to the body wall typically by two short roots between the posterior end of the nerve cord and the origin of the dorsal retractor. The ventral retractor is very slender, as compared with the large, thick, dorsal retractor.

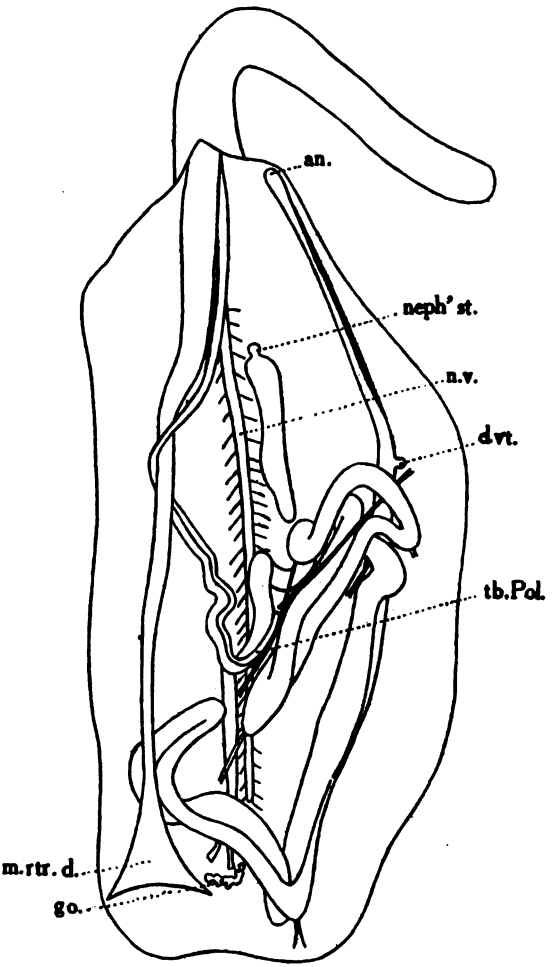


FIG. 10.—DISSECTION OF PHASCOLION STROMBI. × 6½. *an*, ANUS; *dvt*, DIVERTICULUM; *go*, REPRODUCTIVE ORGAN; *m. rtr.d*, DORSAL RETRACTOR MUSCLE; *neph'st*, NEPHROSTOME; *n. v*, VENTRAL NERVE CORD; *tb. Pol*, POLIAN TUBULE.

The alimentary tube (fig. 10) consists of (1) a slender anterior division held to the ventral side of the body by several muscle fibers and terminating in a loop attached by a strong strand of muscle fiber to the left of the nerve cord a short distance in front of its posterior end, and (2) a second division, made of one chief loop attached on the right side of the posterior end of the body immediately behind the right edge of the dorsal retractor. This second loop consists of a

Digitized by Google

wide, thin-walled portion, a twisted part showing a tendency to form a coil, and a straight rectum, on which a small diverticulum is found. The anus lies at a considerable distance (2 or 3 mm.) in front of the nephrostome. A simple Polian tube of wide caliber extends along the dorsal side of the œsophagus to a point considerably beyond that at which the alimentary tube leaves the ventral retractor.

The single (right) nephridium is large, and extends in specimens of the common variety about half the distance between the nephrostome and the posterior extremity of the body. It is closely attached along its ventral line to the wall of the body by several strands.

The reproductive organ is situated on the right side of the posterior end of the body cavity, a convoluted ridge, beginning close to the posterior end of the ventral nerve cord and extending obliquely over the base of the right root of the ventral retractor, on a line continuous with that of the attachment of the dorsal retractor.

VARIETIES.

The most interesting fact in regard to this species is its extraordinary plasticity, its tendency to form modifications and probably germinal variations. How far this diversity in external features is due to the direct action of the environment, as, for instance, the kinds of empty shells or tubes which the worms inhabit, their food supply, temperature of the water, etc., and how far it may be determined by heredity are questions which can be answered fully, of course, only by breeding and rearing the animals.

PHASCOLION STROMBI var. TUBICOLA (Verrill).

This variety is identical with *Phascolosoma tubicola* described by Verrill (1873) as a new species based on certain superficial features which were believed to distinguish it from the earlier described *Ph. cæmentarium* (Quatrefages). I have dissected a sufficient number of specimens in the National Museum named by Verrill "*tubicola*" to determine from a study of their internal as well as external structure that this form is identical with *Ph. strombi*, of which it is a local variety extending from Casco Bay to the waters about Cape Ann. I have retained Verrill's term *tubicola* as a varietal name out of respect for the rule of priority in nomenclature, though it is not a distinctive descriptive expression. The variety that I have called "*fusca*," for example, is a tubicolous form the range of which overlaps that of *tubicola*. A better descriptive term for this variety would be *pullacea*.

Verrill describes it as having the posterior end of the body "transversely wrinkled and rough, and covered with small round, somewhat raised verrucæ or suckers." The holdfasts, or triangular chitinous hooks, are said to be more numerous, sharper, and darker-colored

Digitized by Google

than in the typical *Ph. cæmentarium* (=*strombi*). The papillæ of the anterior part of the body are more prominent, the skin is darker, thicker, and more opaque, and Verrill found no hooks upon the introvert. The habitat of the form is "Off Casco Bay, 60 to 94 fathoms; near St. George's Bank, 85 to 150 fathoms."

A part of the specimens that I have examined from Casco Bay and the most of those from around Cape Ann correspond to Verrill's description, except that, like other varieties of *Ph. strombi*, they have a zone of hooks upon the introvert. The well-known fact that the hooks of the introvert are deciduous in some sipunculids makes the presence or absence of hooks, however, of little moment.

PHASCOLION STROMBI var. FUSCA, new variety.

The dark-colored, markedly papillate variety just described is by no means sharply differentiated from the common widely spread form with smoother skin (particularly at the posterior end of the body) and usually of a light yellowish-brown or orange color. This common form is found from Labrador southward at least as far as Point Judith and the deeper water along the edge of the continental shelf near the fortieth parallel (stations 793, 871, 895, 1093). It is found at intervals between these extreme localities and even in the same general region where the swarthy variety, *tubicola*, occurs. Thus specimens from near the Isles of Shoals (stations 44B and 76B) and off Nahant (station 30) have the color and other features of the typical form, except that the papillæ at the posterior end of the trunk and elsewhere are prominent, just as in individuals of the variety *tubicola* from the neighboring Cape Ann region.

Type.—Cat. No. 8373, U.S.N.M. From Gulf of Maine, str. *Bache*, 1873.

PHASCOLION STROMBI var. ALBA, new variety.

It is obvious that the kind of shell or tube in which individuals of this species live has much to do in determining their extraordinarily variable appearance. Thus a well-marked form which may be described as variety *alba* is found in small gasteropod shells in the shallow waters about Woods Hole, the Elizabeth Islands, Point Judith (station 799, 13 fathoms), and off Block Island (station 815, 15 fathoms).

Specimens of this variety are about two-thirds the size of the typical form, with a trunk 10 mm. in length and introvert 15–20 mm., for example. The color is white or gray. The surface of the body is remarkably smooth, especially at the posterior end, where the minute, slender, conical papillæ are hardly visible with a hand lens magnifying 10 diameters. The nipple-shaped papillæ upon the base of the introvert and the adjacent part of the trunk are visible with a lens, but the conical papillæ upon the introvert are exceedingly minute. A broad zone immediately behind the tentacles is studded

Digitized by Google

irregularly with numerous slender, sharp, recurved hooks, dark brown at the tip. The chitinous holdfasts near the posterior end of the trunk are blunt, U-shaped, and of a light yellowish-brown color.

Type.—Cat. No. 16323, U.S.N.M. From Station No. 79, north of Nashawena.

PHASCOLION STROMBI var. HYALINA, new variety.

Two specimens of this remarkable form, which should possibly rank as a distinct species, were dredged from 238 fathoms at station 895, near the fortieth parallel, south of Marthas Vineyard (type locality). Another small female came from 365 fathoms in the same region (station 894). All were inhabitants of the tubes of the annelid, *Hyalinœcia*.

The body of a contracted specimen is nearly cylindrical, with somewhat truncated extremities. The larger specimens, with the introvert completely retracted, are 22–25 mm. in length and 4–5 mm. in diameter; the smallest, a sexually mature female, is 10 mm. long, 2 mm. in diameter. The introvert in the contracted specimens is about two-thirds the length of the trunk, and the conclusion may be safely drawn that its length in the living animal does not exceed that of the trunk.

The body wall is thin, translucent, of brownish-gray color with a pearly luster. The skin is smooth, the papillæ at the posterior extremity of the trunk being minute and those at the anterior extremity not conspicuous. No papillæ are found in the region of the holdfasts or in the adjacent middle third of the trunk. The holdfasts are light brown, capped with a sharp point extending forward.

The retractor muscles resemble those of other varieties in that the attachment of the dorsal muscle is single, whereas that of the ventral has two roots, but the attachment of the latter is at the extreme posterior end of the body opposite that of the former, and not slightly in front of it as in other varieties. The single (right) nephridium is remarkably short. The eggs are large, oval, and opaque, 150μ by 170μ, or 150μ by 160μ in diameter (in alcohol). The above measurements were taken from eggs from the cœlom of the small female, the trunk of which was only 10 mm. long, and hence it is evident they are large as compared with the size of the body. Eggs of the common variety, *fusca*, from Boon Island, for example, are only 106μ in diameter, though eggs throughout the species vary much in size and in translucency.

Type.—Cat. No. 15119, U.S.N.M.

PHASCOLION STROMBI var. GRACILIS, new variety.

Station 921, lat. 40° 07′ 48″ N.; long. 70° 43′ 54″ W.; 67 fathoms, green mud.

Station 922, lat. 40° 03′ 48″ N.; long. 70° 45′ 54″ W.; 71 fathoms, green mud and sand.

Station 949, lat. 40° 03′ N.; long. 70° 31′ W.; 100 fathoms, yellow mud.

Digitized by Google

Station 998, lat. 39° 43′ N.; long. 71° 32′ W.; 302 fathoms, green mud.

Station 1025, lat. 39° 49′ N.; long. 71° 25′ W.; 216 fathoms, green mud.

Station 1038, lat. 39° 58′ N.; long. 70° 06′ W.; 146 fathoms, sand and shells.

Station 2177, lat. 39° 33′ 40″ N.; long. 72° 08′ 45″ W.; 87 fathoms, green mud and sand.

Stations 89–91B, lat. 42° 05′ N.; long. 67° 49′ W.; 110 fathoms, soft mud and sand.

This variety was found on both sides of the 100-fathom line south of Marthas Vineyard near the fortieth parallel, and at a similar depth off the northwest border of St. Georges Bank east of Cape Cod (stations 89–91B).

Specimens from station 921 are incased in cast shells of *Protula;* that from 2177 is accompanied by a tube probably of a sabellid (elastic membrane covered with grains of sand); those from 89–91B are in *Dentalium* shells and one individual in the shell of a small gasteropod. Two small specimens of the typical form were taken at the last-mentioned station.

Without doubt the external peculiarities of this variety are produced by the character of the tubes in which the individuals live; the smooth, elongated body, the shapes of the holdfasts, the length of the introvert, and even the form of the nephridium are clearly adaptations to the life within the slender, smooth-walled tube of *Protula* or shell of *Dentalium.* Moreover, it seems probable that these characteristics are determined anew during the lifetime of each individual by the direct action of the tube or shell upon its occupant.

Characteristics.—The body and introvert are long and slender, the introvert of about the same length as the trunk. The trunk is nearly smooth, except near the anterior extremity. Holdfasts lie in a broad zone, which in front extends to the middle of the trunk. It inhabits straight tubes or shells. The ventral muscles when expanded show two long, slender roots. The attachment of the dorsal muscle posteriorly is thicker laterally than in the middle, where it shows a tendency to break apart into several distinct strands. The nephrostome is crescentic with a slender neck.

The introvert, judging from the examination of a few specimens which are mostly somewhat contracted, is of about the same length as the trunk, slender and smooth, except at the base where it is covered with small papillæ. The trunk at its junction with the introvert is covered with very prominent papillæ, in a narrow zone behind which the papillæ decrease rapidly in size. The posterior half of the trunk is smooth, the papillæ being very minute. The holdfasts extend forward to about the middle of the trunk and in some individuals are

Digitized by Google

extraordinarily variable in shape; the chitinous part of the papilla is usually crescentic and provided with a point projecting forward, but in some individuals the convexity of the crescent extends laterally, or even backward. Double crescents and rings of chitinous material are sometimes found upon the attaching papillæ. These holdfasts therefore appear to be more variable than in other varieties of the species.

There are 16 tentacles. Dark-colored, recurved hooks are scattered over a broad zone separated from the tentacles by a distance about equal to its width. These hooks, though not regularly distributed, may be considered as forming eight or nine irregular rows.

This variety differs internally from others in two or three noticeable respects. The posterior attachment of the dorsal retractor muscle shows a tendency to break into several distinct strands, a fact which is due to the shape of the body wall at the point where attachment is made. The second peculiarity is the shape of the eggs, which are ovoid, translucent, and about 103 by 124 in diameter. The yolk membrane, or zona radiata, is of medium thickness (3.8 or 4) and has distinct pore canals. Finally the crescentic nephrostome joins the nephridium by a somewhat slender neck.

PHASCOLION STROMBI var. CANADENSIS, new variety.

Bay of Fundy. In shells of *Dentalium* and of gasteropods.

Stations 43–46, lat. 43° 06′ N.; long. 65° 06′ W.; 90 fathoms, fine sandy mud.

Station 47, lat. 43° 10′ N.; long. 65° 12½′ W.; SE. ½ S. from Cape Sable about 22 miles, 59 fathoms, pebbles and sand. In tubes of *Pectinaria*, tubes of cement, gasteropod shells.

Station 55, mouth of Bedford Basin, 33 fathoms, mud; in *Pectinaria* tubes.

Type.—Cat. No. 8582, U.S.N.M.

Stations 82–83, lat. 44° 22′ N.; long. 65° 28′ W.; Chebucto Light, N. ½ E. 9 miles, 57 fathoms, mud and sand.

Station 103, lat. 44° 02′ N.; long. 63° 20′ W.; 29¾ miles south of Chebucto Head, 110 fathoms, fine sand and mud.

Stations 106–108, near last. In *Hyalinœcia* tubes.

Station 2506, lat. 44° 26′ 00″ N.; long. 62° 10′ 00″ W.; 127 fathoms, dark-brown mud.

Station 2697, lat. 47° 40′ 00″ N.; long. 47° 35′ 30″ W.; 206 fathoms, green mud, black specks.

In certain localities off the coast of Nova Scotia a form of *Ph. strombi* is found with a remarkably short introvert, with a smooth, lustrous skin in the region of the holdfasts, and a tendency of the dorsal retractor to be divided at the posterior attachment into two roots. These characters during the earlier part of my study appeared to be of specific importance, but the examination of many speci-

Digitized by Google

mens of this form has convinced me that it is to be regarded as merely an unstable variety of a very plastic species.

Although it is exceedingly difficult to estimate accurately the length of the introvert in specimens preserved in all states of contraction, there seems to be no room for doubt that even in the same region off Nova Scotia a form with an introvert shorter than the trunk is found along with the common type. This may be due in part to the fact that these individuals inhabit tubes of *Pectinaria* or of *Hyalinœcia* or the shells of *Dentalium*, which elongates the trunk by compression, and moreover makes the skin in the region of the holdfasts lustrous.

Another peculiarity to which I was at first inclined to attach much importance is the fact that the specimens from certain localities near Halifax either have the dorsal retractor muscle slightly divided at the base, or else it readily separates into two parts in making a dissection. This, however, is not a constant character. Specimens from the same region in most cases have an undivided dorsal retractor.

These peculiarities, although not of sufficient importance to establish a distinct species, do mark the presence of a tendency which may be expressed as a variety or strain, which may be called *canadensis*, the characteristics of which may be briefly summarized as follows, though it should be noted that there is such a mixture constantly occurring between this and the typical variety, *fusca*, as to make it impossible in some instances to make these distinctions: Introvert from one-third to one-half the length of the trunk in extreme cases, but in other individuals equal in length to the trunk. The skin is smooth, except for prominent papillæ near the base of the introvert which are oval, with a small, nipple-shaped tip, or cylindrical. Minute, slender, conical papillæ are found at the posterior end of the body. The region covered with holdfasts is smooth, lustrous, and often iridescent; this region extends forward as far as the middle third of the trunk, which is covered with very minute papillæ but otherwise smooth. The dorsal retractor is distinctly divided at its attachment to the body wall at the posterior end of the trunk. There is less difference in size between the dorsal and ventral retractors than in the typical variety. The nephridium in this form is relatively short, and the nephrostome, as in the variety *gracilis*, has a slender neck.

PHASCOLION STROMBI var. LÆVIS, new variety.

Station 160, 5 miles off Thatchers Island, in 54 fathoms.

Type.—Cat. No. 15109, U.S.N.M.

This variety, which I was at first inclined to regard as a distinct species, lives in tubes constructed of fine pebbles of different sizes firmly cemented together and consisting of two parts, namely, that

Digitized by Google

covering the trunk, similar to the tube of the variety *tubicola*, and a slenderer, extremely long, tapering portion that covers the introvert. The latter part of the tube, like the former, contains minute pebbles and particles of mud that are graduated in size, becoming finer toward the distal end and embedded in a parchment-like material, which alone forms the small anterior extremity of the tube.

This variety, of which I have examined only one complete specimen, is characterized externally by having an unusually long, slender, smooth, and light-colored introvert (pl. 60, fig. 13) that is somewhat sharply marked off from the thicker, darker-colored trunk, which at the posterior end is sharply truncated and of a light brown color.

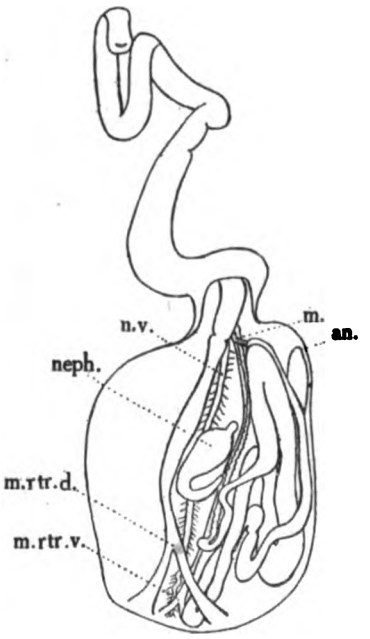


FIG. 11.—DISSECTION OF PHASCOLION STROMBI VAR. LÆVIS. × 6. *an*, ANUS; *m*, SUSPENSORY MUSCLE OF INTESTINE; *m. rtr. d*, DORSAL RETRACTOR MUSCLE; *m. rtr. v*, VENTRAL RETRACTOR MUSCLE; *neph*, NEPHRIDIUM; *n.v*, VENTRAL NERVE CORD.

The length of the trunk of the single entire specimen is about 6½ mm.; the introvert is about twice as long; the greatest diameter of the trunk is about 2 mm., of the introvert about seven-eighths mm. The papillæ of the anterior part of the trunk are small, inconspicuous, oval elevations; and the rest of the trunk is almost smooth, except that minute epidermal organs are scattered over the region immediately in front of the extremely small, crescentic holdfasts which occupy a zone very near the posterior end of the body.

The introvert is smooth, except that minute papillæ are scattered over its posterior third.

The longitudinal muscle layer is continuous and lustrous. The dorsal retractor muscle (fig. 11) is much larger than the ventral, and is attached at the posterior end of the cœlom by two widely separate roots,[1] each with a broad attachment. The two roots of the dorsal muscle unite at a distance from the

[1] Since making the dissection on which this description was based, I have frequently found that in certain individuals of *Ph. strombi* there is a marked tendency for a really undivided dorsal retractor to split in two at the base under the slightest stress, so that in dissection it is difficult to ascertain whether the dorsal retractor is actually divided or single. Hence too much taxonomic weight must not be placed upon this anatomical difference. Accordingly, with the small amount of material at hand, I am inclined, finally, to describe this form as a variety of *Ph. strombi*, though the tube which it constructs and its long, smooth introvert, not to mention the dorsal retractor muscles, are distinctly peculiar; for *Ph. strombi*, particularly of the tube-making variety, is very common in the region where this specimen was found, and it would be expected that aberrations or mutations would occur, and it is such that I believe *Ph. strombi* var. *lævis* to be.

Digitized by Google

posterior end of the body equal to about one-fourth the length of the trunk. The ventral muscle is slender and inconspicuous. It is attached by two cylindrical roots, one on each side of the posterior end of the nerve cord.

The long, slender esophagus joins a wide intestine of about six loops extending backward and forward. A prominent strand of muscle fibers extends from the anterior intestinal loops into the region of the introvert, and less conspicuous strands elsewhere hold the intestine to the body wall. The single (right) nephridium is large, and has a prominent nephrostome. The nerve cord is a relatively wide band.

MODIFICATIONS IN THE SOUTH.

The number of local varieties of this species probably will be found to be even greater when the southern part of its range is more thoroughly explored. A specimen from off Cape Charles, Virginia (station 2003, 641 fathoms), is typical in internal features in all respects, but externally it is remarkable for its peculiar dark greenish-gray color. It has a thick integument covered with prominent papillæ, and an unusually distinctly marked anus. Except for the peculiar greenish-gray hue it resembles the variety *tubicola* from the region of Cape Ann. Its shape indicates that it lived in a tube of cement.

Other specimens from the same southern region, that is, from the fortieth parallel southward to Cape Hatteras, have a noteworthy internal peculiarity, namely, the posterior attachment of the ventral retractor does not lie behind the posterior end of the nerve cord, as in other varieties of this species, but beside it to the left, thus showing a more prominent asymmetry in the internal organization than in any other variety of the species.

Externally these specimens from different southern localities differ much. Those from the shells of *Dentalium solidum* (station 2733, 944 fathoms, off Cape Charles; station 2207, 1,071 fathoms, just south of the fortieth parallel) have a thin, smooth skin of orange brown color. Those from the gasteropod *Sipho pygmæus* (station 898, 300 fathoms, off Norfolk, Virginia) have a smooth, whitish skin and an external appearance like those described as the variety *alba*.

The crowding aside of the extremity of the retractor in reference to that of the nerve cord has made a still further modification in certain individuals inhabiting the shells of *Dentalium solidum*, in that the attachment of the ventral retractor is undivided; this, however, is not true of the specimens from the shells of *Sipho pygmæus*. Selenka (1883) likewise found in a specimen from the West Indies, which he

Digitized by Google

describes as *Ph. tubicola* (Verrill) (=*Ph. strombi*), that the ventral retractor has a single root attached at the left of the posterior end of the nerve cord, as is shown by his figure 82. The three individuals from the West Indies which he examined, moreover, lived in tubes of cemented mud and sand. As stated above, I have found this peculiarity in specimens from the shells of *Dentalium solidum*, so that it would appear to be a southern characteristic or tendency not determined by the nature of the shell or tube which the worm inhabits, but hereditary.

PHASCOLION ALBERTI Sluiter.

This form, which Sluiter (1900) describes, apparently differs only in external features from *Ph. strombi*, which it is like in habits and in the arrangement of its retractor muscles. The length of the introvert is described as two-thirds that of the trunk, in which respect it resembles many of the specimens of *Ph. strombi* from the same general region (vicinity of Nova Scotia), which show a tendency to have a shorter introvert than elsewhere. The papillæ of the anterior and middle parts of the trunk, however, rather than of the posterior end, bear chitinous denticles pointing forward, whereas those near the posterior extremity are capped with a perforated, oval crown of chitinous material. The ventral nerve cord is prolonged beyond the attachment of the ventral retractors, passing between the two roots.

This form was taken in considerable abundance by the Prince of Monaco at his station 161, off Newfoundland, lat. 46° 04′ 40″ N.; long. 49° 02′ 30″ W., in 1,267 meters, and off Cape Finisterre in 1,674 meters. It has not been found, to my knowledge, by any expedition from the United States that has explored the same general region.

Genus DENDROSTOMA Grube.

This genus includes a few species which are distinguished from their natural allies of the genus *Phascolosoma* by the tree-like branching of their tentacles, which are ramifications of from four to eight main trunks. The longitudinal muscle layer is continuous, the nephridia free, and the intestinal coil unattached behind. The trunk in most species is short and thick. The short introvert is provided with hooks or spines, except in *D. peruvianum* Collin. The Polian vessel (contractile tube) is provided in most cases, though not in *D. blandum* Selenka and De Man, with numerous cæca. These species inhabit tropical seas.

Of the six recorded species *D. pinnifolium* Keferstein has four retractor muscles, the others have two. *D. pinnifolium* Keferstein, as well as *D. alutaceum* Grube, is found in the West Indies (St. Thomas, Selenka); *D. peruvianum* Collin off the Peruvian coast; *D. blandum* Selenka and De Man, *D. signifer* Selenka and De Man, and *D. spinifer* Sluiter in the western part of the Pacific Ocean.

Digitized by Google

Selenka (1883) called attention to the fact that this genus includes species which would naturally be included within the genus *Phascolosoma*, but which may be conveniently segregated until our knowledge of the affinities of the various species of this larger genus is more complete.

DENDROSTOMA ALUTACEUM Grube.

Station 2280, off Cape Hatteras, lat. 35° 21′ N.; long. 75° 25′ 30 ′ W.; 16 fathoms, gray sand and broken shells.

Cedar Keys, Florida, on coral, 1 fathom.

Dry Tortugas, Florida.

Key West, Florida.

Body pear-shaped (fig. 12 and pl. 59, fig. 9), with the greatest width near the posterior end, which terminates in a papilla-like elevation. Introvert cylindrical; the anterior half is smooth, behind which there is a wide (2 mm.) band of prominent, recurved hooks. The cuticular covering the base of the introvert is divided into rectangular blocks. The surface of the trunk is marked with fine transverse furrows, visible only with a lens, separating narrow ridges of cuticula which show minute pits. The body is brownish-flesh-color, the cuticula being suffused with white, so that the general effect in alcoholic specimens is grayish-brown.

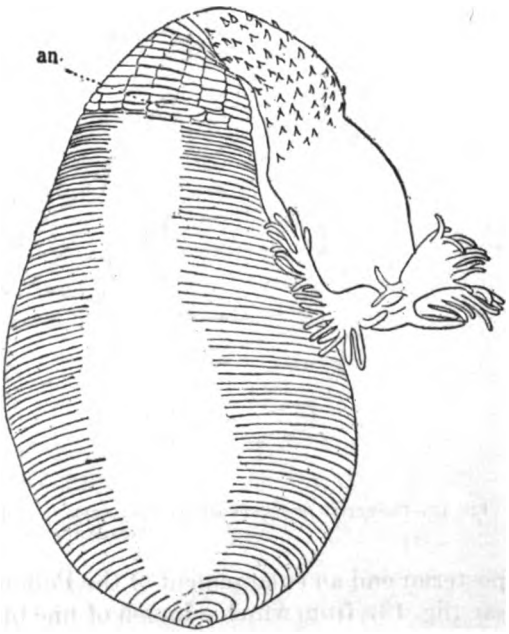


FIG. 12.—DENDROSTOMA ALUTACEUM. × 8½. an, ANUS.

The numerous tentacles are grouped in six tree-shaped bunches, long, slender, and grooved upon their oral surfaces. The color of the tentacles, like the rest of the introvert, is light yellowish-brown, but individual tentacles are flecked with spots of dark brown pigment upon the oral surface, generally both in the middle and near the tip.

The longitudinal muscles of the body wall form a continuous layer; the circular muscles are divided into distinct bundles, which anastomose. The breaks between these bundles of circular muscle fibers give rise to transverse furrows upon the surface of the body.

Digitized by Google

The two large, ventral retractors (fig. 13) have their origin in wide attachments at the posterior end of the middle third of the length of the trunk. The pair of nephridia are very long, and attached to the body wall slightly behind the anus. The œsophagus is slender, and the large coil of the intestine nearly fills the posterior part of the cavity of the trunk. A spindle muscle is inserted in the body wall immediately behind the anus, and muscle strands run from the intestinal coil to each side of the wall of the body slightly in front of the origin of the retractor muscles. The œsophagus bears upon the dorsal surface at its

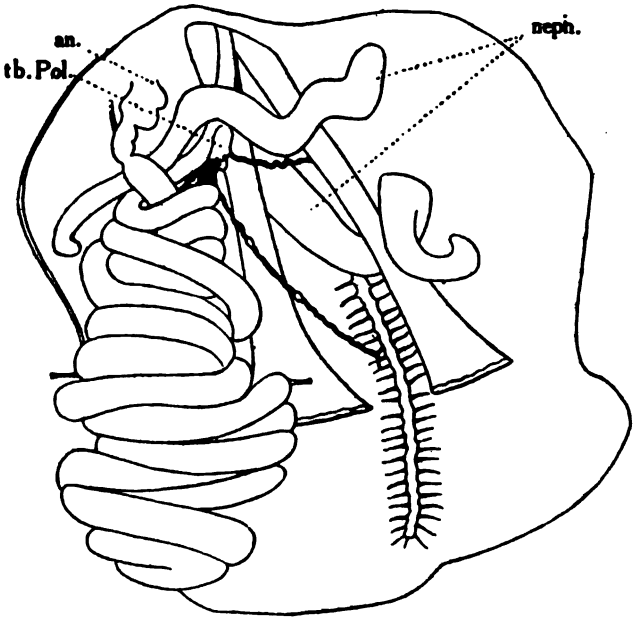


FIG. 13.—DISSECTION OF DENDROSTOMA ALUTACEUM. × 10½. *an*, ANUS; *neph*, NEPHRIDIUM; *tb. Pol*, POLIAN TUBULE.

posterior end an enlargement of the Polian canal in the form of a small sac (fig. 13), from which a bunch of fine blind tubes run backward into the intestinal coil, and isolated tubes extend to the ventral side of the body wall. These tubes when stretched become straight, but, when the tension is relaxed, they take the form of a fine spiral. Varicosities occur at intervals in the larger tubules. Two faintly pigmented eye spots are visible in one of the larger specimens. The cerebral ganglion as seen from above with a low power has nearly a circular contour; a prominent, crescentic cerebral organ extends in front of it. No nuchal organ was observed.

Digitized by Google

Genus PHYSCOSOMA Selenka, 1897.

Phymosomum QUATREFAGES, 1865.
Phymosoma SELENKA, BÜLOW, and DE MAN, 1883.

Longitudinal muscle layer of the body wall in most species discontinuous (continuous in *Ph. capitatum*, new species). Tentacles in a single row, not encircling the mouth, but situated dorsal to it along a crescent opening dorsad. Body covered with papillæ. Hooks, arranged in rings, usually present (not in *Ph. antillarum* Grube and Örsted). Usually four retractors, the dorsal and ventral of each side tending to fuse. Contractile tube in most species without cæca (not in *Ph. antillarum* Grube and Örsted). Eye-spots generally occur (not in *Ph. capitatum*).

PHYSCOSOMA VARIANS (Keferstein).

Phascolosoma varians KEFERSTEIN, 1865.
Phascolosoma perlucens BAIRD, 1868.

This species (pl. 62, fig. 18) is abundant at Key West and at the Dry Tortugas, Florida, and is also found at other points off the southern coast of that State, as at Cape Florida and Key Vaccas. It is abundant among the West Indies (Keferstein, 1866; Selenka, 1883), at the Bahamas (Shipley, 1890), Bermudas (specimens collected for me through the kindness of Prof. E. L. Mark), and occurs also at Ascension Island in the South Atlantic (W. H. Brown, Eclipse Expedition to West Africa, 1889).

The following is a translation of Keferstein's description as given by Selenka (1883):

Trunk three to four times as long as thick, introvert as long as or longer than the trunk. Skin yellowish, thin, somewhat iridescent, with many scattered, large, dome-shaped, rounded papillæ, which are darkly pigmented on the dorsal side of the animal (a dark ring with a light center) and are often grouped together there into spots, giving a marbleized appearance. The diameter of the papillæ is 0.20–0.22 mm. The posterior half of the introvert resembles the trunk in appearance, and the anus is not conspicuous; the anterior half, on the other hand, bears only small papillæ, appears accordingly rather smooth, and is often pigmented with brown, usually transverse, bands. It carries numerous closely-set rows of hooks of very variable number (12–90), which, accordingly, in many cases cover only the most anterior part, but often the whole anterior half, of the introvert. The hooks are very characteristic, broadly leaf-shaped, with the upper point bent to a right angle, and with large, rounded, accessory projections on the inner edge. Between the rows of hooks are hook-papillæ rather regularly arranged. On the anterior part of the introvert, immediately behind the tentacles, is an entirely smooth zone.

Digitized by Google

The 20–28 short tentacles, standing in two lateral rows, do not encircle the mouth, but are situated on the dorsal side of it, encircled by a low collar of integument opening dorsally.

The musculature is strong; the longitudinal muscle layer is split into about 30 (26–32) anastomosing bands, and the circular muscle layer also tends to form bands. Four strong retractors, of which the ventral are attached in the posterior, the dorsal in the anterior part of the middle third of the trunk; and those of the same side are united only in the anterior part of the introvert. Two large eye-spots. Intestinal coil with few whorls, with a complete columellar muscle and a single fastener ventral to the esophagus and the first whorl. Rectum of medium length. Contractile tube simple, only 0.24 mm. thick. Nephridia very long, fastened by a mesentery along the anterior third. Eggs (0.12 mm.) with a thin yolk membrane pierced with fine pore canals. Trunk 35 mm., introvert 42 mm.

The structure of this very variable species has been well described by Shipley (1890).

PHYSCOSOMA ANTILLARUM (Grube and Örsted).

Phascolosoma fuscum KEFERSTEIN, 1862.
Phascolosoma nigriceps BAIRD, 1868.

Key West, Florida, cavities in rocks between tides (Henry Hemphill, 1885). Five specimens.

This species has been found among the West Indies at Muriel, Cuba (U. S. Nat. Mus., Palmer and Riley), St. Croix (Grube and Örsted), St. Thomas (Keferstein), Barbados (Stuttgart Museum, Selenka; U. S. Nat. Mus., Worthing, Barbados, on reef, (H. M. Lefroy) and Jamaica (Baird); off the adjacent mainland of Colombia, Sabanilla, and Venezuela (U. S. Nat. Mus., *Albatross*, 1884), at Puerto Cabello (Grube), and Pernambuco and Goyanna, Brazil (U. S. Nat. Mus., A. W. Greeley). In the Pacific, it has been found on the coast of Costa Rica at Puntarenas (Grube and Örsted) and on the coast of Chile (Baird).

The following description is based largely on Keferstein's account, as given by Selenka (1883), which agrees closely with the facts as I have found them:

Distinctive features.—Introvert one-half to one-third the length of the trunk (pl. 62, fig. 20), which in a partially contracted specimen is four or five times as long as thick (pl. 62, fig. 19). The thick skin is everywhere covered with prominent, flat, dark-brown papillæ between which the whitish or yellowish skin appears. Papillæ at the posterior end of the trunk and especially at the base of the introvert are large, rough, and dark-colored, forming at the anterior extremity black plates separated only by narrow fissures. On the introvert the papillæ are further separated and are conical with a sharp apex.

Digitized by Google

In the front part of the introvert a smooth zone is sharply marked off; and a small, upright collar, split dorsally, lies at the base of the numerous (50–80) long, thread-shaped tentacles, which are often transversely striped with alternating rings of brown and white. The longitudinal muscle layer consists of separate, frequently anastomosing bands (30 in the middle of the trunk, 20 in the front, but subject to much variation). Four retractor muscles arise near one another in the second third of the trunk, but immediately unite on each side to form a single, lateral muscle. Brain with distinct eye spots. Intestinal coil of few (about 20) whorls. Rectum long. A columellar muscle fastens the intestine in front of the anus and at the posterior end of the trunk. The contractile vessel on the esophagus and on the first intestinal coil has many finger-shaped diverticula terminating in tubular cæca. Nephridia very long (over one-half the length of the trunk) and attached along almost the whole length to the body wall by a fold of peritoneum.

One of the specimens from Key West is unusually large, the trunk being 47 mm. in length. The usual length of the trunk is about 30 mm.; introvert 18 mm.

PHYSCOSOMA CAPITATUM, new species.

Station 2231, lat. 38° 29′ N.; long. 73° 09′ W., east of Cape May; 965 fathoms, gray ooze; temperature at bottom, 36.8° F.

Station 2103, lat. 38° 47′ 20″ N.; long. 72° 37′ W., east of Cape May; 1,091 fathoms, Globigerina ooze; temperature at bottom, 39° F.

Station 2685, lat. 39° 35′ N.; long. 71° 02′ 30″ W., south of Marthas Vineyard; 1,137 fathoms, green mud with white specks; temperature at bottom, 37.9° F.

Station 2029, lat. 39° 42′ N.; long. 70° 47′ W.; south of Marthas Vineyard; 1,168 fathoms, gray mud; temperature at bottom, 38½° F.

Type.—Cat. No. 4067, U.S.N.M.

Station 2093, lat. 39° 42′ 50″ N.; long. 71° 01′ 20″ W., south of Marthas Vineyard; 1,000 fathoms, foraminifera, sand and mud; temperature at bottom, 39° F.

Station 2192, lat. 39° 46′ 30″ N.; long. 70° 14′ 45″ W., south of Marthas Vineyard; 1,060 fathoms, gray ooze; temperature at bottom, 38.6° F.

Station 2572, lat. 40° 29′ N.; long. 66° 04′ W., southeast of Georges Bank; 1,769 fathoms, gray ooze; temperature at bottom, 37.8° F.

Station 2531, lat. 40° 42′ N.; long. 66° 33′ W.; southeast of Georges Bank; 852 fathoms, gray mud; temperature at bottom, 38.4° F.

Station 2530, lat. 40° 52′ 30″ N.; long. 66° 24′ W., southeast of Georges Bank; 956 fathoms, gray ooze; temperature at bottom, 38.4° F.

Digitized by Google

Station 2528, lat. 41° 47′ N.; long. 65° 37′ 30″ W., east of Georges Bank, 677 fathoms, brown sand; temperature at bottom, 38.7° F.

Station 2072, lat. 41° 53 N.; long. 65° 35′ W., south of Cape Sable, east of Provincetown, Massachusetts; 858 fathoms, gray mud; temperature at bottom, 39° F.

The range of this species extends from the latitude of Cape Cod (station 2072) southward as far, at least, as that of Cape May (station 2231). It is found at depths varying from 677 to 1,769 fathoms. No other species of this genus, with the exception of *Ph. lovénii* Koren and Danielssen, has been found as far north, the most of the species being inhabitants of tropical or subtropical waters. The temperature of the water from which the specimens were taken in summer and autumn was 36°–39° F.

This species differs from others of this genus in that the longitudinal muscle layer is entirely continuous, the almost universal condition in *Phascolosoma*. The eggs are spherical, as in *Phascolosoma*, and there are no eye-spots visible upon the surface of the cerebral ganglion; whereas in most species of *Physcosoma* the eggs are said to be elliptical and flattened, and eye-spots are present. The peculiar arrangement of the tentacles, however, dorsal to the mouth in a crescent opening dorsad (pl. 51, fig. 15), places this species in the genus *Physcosoma*.

Distinctive features.—Trunk ovate with thick, rough, dark-brown integument, thickly studded at the posterior end with broad, yellowish-brown and hence conspicuous papillæ, which elsewhere are thinly scattered over the trunk (pl. 61, fig. 16; pl. 62, fig. 21).

Introvert cylindrical, shorter than the trunk, which it resembles in the color and texture of the skin, except in the anterior fourth, which is sharply contrasted with the rest by having a light orange color and thin walls, forming an oval "head" (pl. 62, fig. 21). The main part of the introvert is covered with light yellowish-brown papillæ, which are about twice as large at the proximal as at the distal end of this region. Papillæ of smaller size extend over the base of the orange-colored "head," around which about 35 rows of minute hooks (pl. 61, fig. 16) extend. There are 14 tentacles, arranged in the characteristic fashion of *Physcosoma*, dorsal to the mouth in a crescentic row opening dorsad (pl. 61, fig. 15). A collar consisting of an annular fold of integument surrounds the anterior part of the "head," immediately behind the mouth and tentacles.

There are four short retractor muscles of which the ventral, which are much the larger, are attached near the posterior end of the trunk; the slender, dorsal pair are attached slightly in front of the others, and unite together posterior to their union with the ventral pair. There are no eye-spots. The eggs are spherical, small, and transparent, covered with a yolk membrane pierced with distinct pore canals.

Digitized by Google

The size of the larger specimens, extended, is: trunk 16 mm. long and 7 mm. thick; introvert 12 mm. long and 1.5 mm. thick. Still larger specimens have a trunk 17 mm. long and 9 mm. thick, and 19 mm. by 7 mm.

The integument of the posterior end of the trunk in some specimens is so thick as to suggest a shield like that of *Aspidosiphon*, but this is not a constant characteristic.

The papillæ are generally low, flat domes, capped by a central rounded protuberance.

The nerve cord is prominent, and is held to the ventral wall of the introvert by a mesentery; the lateral nerves are inconspicuous. A long esophagus (fig. 4) joins an intestinal coil of about 20 whorls held by a prominent spindle muscle attached posteriorly to the tip of the body wall. A muscle strand extends from the middle of the esophagus forward to the junction of the two ventral retractors, in front of which the anterior part of the esophagus is fastened to the retractors by a fold of peritoneum. A short, simple Polian tube or contractile vessel lies over the united portion of the pair of dorsal retractors.

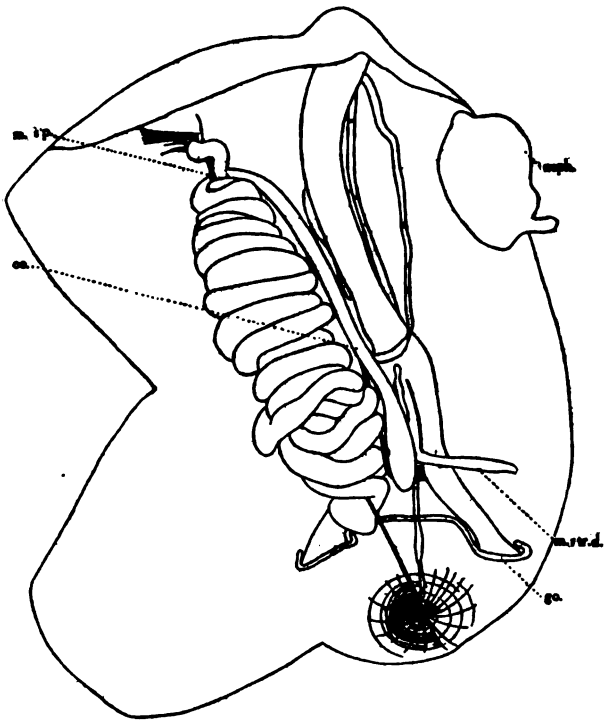


FIG. 14.—DISSECTION OF PHYSCOSOMA CAPITATUM. × 4½. *go*, REPRODUCTIVE ORGAN; *m. rtr. d*, DORSAL RETRACTOR MUSCLE: *m. sp*, SPINDLE MUSCLE; *neph*, NEPHRIDIUM; *œ.* ESOPHAGUS.

The nephridia (fig. 14) are attached to the body wall nearly opposite the anus. They are of medium length.

This species varies much in regard to the position of the points of attachment of the retractor muscles to the body wall. Thus in one specimen both pairs were attached near together near the middle of the trunk. In a small, young specimen the ventral retractors have the usual attachment near the posterior end of the body, whereas

Digitized by Google

the slender dorsal muscles are joined to the body wall much further forward than in the individual which I have figured (fig. 14), and underneath the nephridia. In general, in the few specimens which I have dissected, the position of the attachment of the dorsal retractors varies from about the posterior end of the first third of the trunk backward to the posterior end of the third quarter.

The resemblance of this species to *Phascolosoma* has been noted above. Like *Phascolosoma scutigera* Roule and *Ph. approximatum* Roule which it resembles closely in its proportions, its musculature and other respects, it suggests also the genus *Aspidosiphon*, though to a less extent than the former of the two species mentioned. A posterior shield is distinctly suggested in some specimens by the thickening of the integument of the posterior end of the trunk and, to a less extent, at the anterior extremity.

It seems not impossible that some of the deep-sea sipunculids described by Roule (1907) as species of *Phascolosoma* belong rather in *Physcosoma*, a genus which Roule apparently does not recognize as including several species originally described as *Phascolosoma* (as, for instance, *Ph. agassizii* Keferstein, *Ph. varians* Keferstein). Thus Roule's *Phascolosoma vulgare* de Blainville var. *multipapillosa*, so far as one can judge by his figure (fig. 89) and very brief description in which he compares this form to *Phascolosoma* (=*Physcosoma*) *agassizii* Keferstein, apparently resembles *Physcosoma*. No statement is made as to whether its longitudinal muscle layer is continuous, as in *Phascolosoma vulgare*, or discontinuous as in *Physcosoma agassizii*. Superficially, and as regards its retractor muscles, it resembles *Physcosoma capitatum*. The one individual of this "variety *multipapillosa*" came from Mogador, West Coast of Africa, and a depth of 1,050 meters. The incomplete crown of tentacles in *Phascolosoma approximatum* Roule, suggests that possibly this also is a species of *Physcosoma*.

Genus ASPIDOSIPHON Grube.

Individuals of this genus have a distinct shield in front of the anus and one at the posterior extremity of the body. The introvert is much slenderer than the trunk, with which it is connected ventral to the anal shield. Rings of hooks are found in most species upon the introvert. The longitudinal muscle layer is either continuous or discontinuous. Only the ventral retractors are present, and they are fused more or less completely.

Most of the species of *Aspidosiphon* that have been described inhabit the Pacific and Indian Oceans. In the Atlantic, *A. armatus* Koren and Danielssen and *A. mirabilis* Théel occur off the coast of Norway and Sweden, *A. mülleri* Diesing is found with *A. venabulum* Selenka and Bülow off the west coast of Africa (Fischer, 1894), and

Digitized by Google

in the Bay of Biscay and the Azores (Sluiter, 1900), and *A. speculator* has been taken at St. Vincent (Cape Verde Islands). *A. truncatus* Keferstein, which occurs both at Panama (Keferstein, 1866) and Mauritius (Selenka, 1883), is also likely to be found in the Atlantic.

ASPIDOSIPHON PARVULUS, new species.

Station 2280, off Cape Hatteras, lat. 35° 21′ N.; long. 75° 21′ 30″ W.; 16 fathoms, gray mud and broken shells. Two specimens. With *Phascolosoma verrillii* Gerould and *Dendrostoma alutaceum* Grube.

Type.—Cat. No. 15118, U.S.N.M.

The larger of the two specimens noted above measures: trunk 4 mm., introvert 2.5 mm. The smaller: trunk 3 mm., introvert 1.5 mm. The introvert of both specimens is partially retracted, though that of the larger specimen is almost completely extended.

The most distinctive features are: the diminutive size; introvert shorter than the trunk (pl. 61, fig. 17) and beset with numerous, minute, slender hooks; anterior shield irregularly covered with prominent spines; posterior shield divided by radial furrows into rounded or squarish plates; the longitudinal muscle layer continuous.

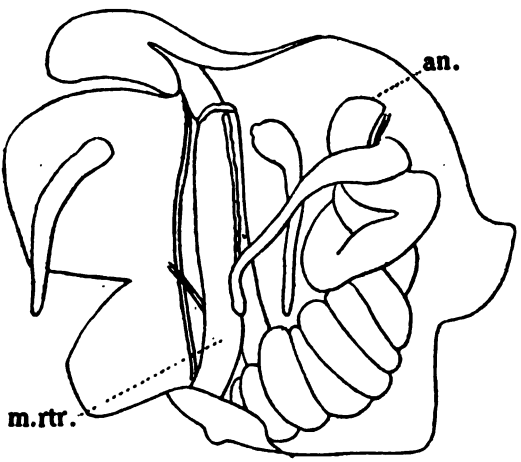


FIG. 15.—DISSECTION OF ASPIDOSIPHON PARVULUS. × 17½. *an*, ANUS; *m.rtr*, RETRACTOR MUSCLE.

The trunk is short and thick, the thickness being about one-half the length in a slightly contracted specimen. The color is light yellowish- or grayish-brown; the anterior and posterior shields, which are prominently marked off, are deep yellowish-brown. The anterior shield is covered with prominent spines, of which those along the margin are sharply conical, those in the center flat. The posterior shield is divided by radial and circular furrows into squarish or rounded, partially separate plates, and at its center is a knob-shaped elevation. The entire shield is covered with a minutely granular embossing, visible with a magnification of 17 diameters (pl. 61, fig. 17).

The trunk is smooth, but is covered with flat epidermal organs with a circular outline and a central depression. They are visible with a hand lens only on the posterior part of the trunk in front of the posterior shield, where they are largest. They gradually diminish in size from that region forward, and are visible on the anterior half of the trunk only with a magnification of 60 diameters or more. The

Digitized by Google

surface of the trunk in the larger specimen is blocked off into rectangular elevations by the contractions of the underlying muscles.

The introvert, which is shorter than the trunk, is cylindrical, and covered with exceedingly minute, slender, recurved hooks, which can not be seen easily with a magnification of less than 60 diameters.

The posterior end of the retractor muscle (fig. 15) is divided, and the two roots (representing the right and left ventral retractors) are inserted on each side of the posterior shield. A muscle strand extends to the body wall from the retractor immediately in front of the angle between the diverging roots. The longitudinal muscles of the body wall form a continuous layer. The long, slender nephridia are attached by a fold of peritoneum to the body wall. The intestine makes a coil of about 10 wide turns, and is supported by a very strong spindle muscle. The ventral nerve cord projects prominently into the body cavity.

This form somewhat resembles *A. mirabilis* Théel of the west coast of Norway and Sweden, but, aside from size, it differs from it in the smoothness of the trunk, the presence of prominent spines on the anterior shield, the attachment of the nephridia by folds of peritoneum, and other less marked features.

ASPIDOSIPHON SPECIOSUS, new species.

Key West, Florida, shore (?). One specimen.

Type.—Cat. No. 16320, U.S.N.M.

Station 2336, off Havana, lat. 23° 10′ 48″ N.; long. 82° 18′ 52″ W.; 157 fathoms, coral bottom. One specimen.

Station 2758, east of Brazil, lat. 6° 59′ 30″ S.; long. 34° 47′ W.; 20 fathoms, broken shells; temperature at surface and bottom, 79° F. One specimen.

Distinctive features.—Introvert nearly or quite as long as the trunk (pl. 62, fig. 22). About 110 rows of fine, single-pointed hooks (fig. 16) on the first fifth of the introvert. Introvert and middle of the trunk smooth. Ends of the trunk covered with polygonal elevations. Both shields furrowed (pl. 62, fig. 22). Longitudinal muscle layer discontinuous. A transverse septum stretches across the cœlom in front of the anus and the nephridia. Ventral retractor muscles fused into one. No eye-spots.

The trunk of the specimen from Key West is 40 mm. in length, the introvert 38–40 mm. in length. The spines on the posterior part of the introvert are exceedingly fine and the introvert is smooth. The anterior and posterior ends of the trunk are covered with polygonal or squarish elevations of a dark-brown color on a grayish field. The middle portion (nearly one-half the length) of the trunk is smooth and of a yellowish-brown color. The shields are dark brown and furrowed. The anterior shield is oval, with its long axis transverse, with 18 short and long furrows at its posterior edge, converging as

Digitized by Google

they run forward toward the base of the introvert. The posterior shield has 22–26 radial furrows, of which only about 15 reach the rounded elevation at the center. The edges of the posterior shield, by the contraction of the circular muscles in front of it, sometimes project above the general surface of the body, so that the radially ribbed, circular shield, rising like a flat dome from the cylindrical trunk in a contracted specimen, suggests an extremely ornamental roof of a Chinese pagoda.

The longitudinal muscle layer consists of about 46 flat, plate-like bands, which anastomose under the anal shield and in the region of the nephridia. The single retractor muscle formed by the fusion of the two ventral retractors is attached to the body wall by two roots, one on each side of the nerve cord at a considerable distance (= two-sevenths the length of the trunk) in front of the posterior shield.

A prominent transverse septum stretches across the cœlom immediately in front of the anus and the openings of the nephridia, thus isolating a small space beneath the anterior shield. The nephridia are not connected with it. They are each attached to the body wall by a short fold of peritoneum extending along about one-fifth or one-fourth of the length of the nephridium. The nephrostome is a prominent fold with a heart-shaped contour connected with the rest of the nephridium by a slender neck. The intestinal coil of many whorls is held to the middle of the posterior shield by a large columellar muscle. There is a large, oval diverticulum upon the rectum near the anus. The rectum is held by a longitudinal fold of peritoneum containing muscle fibers.

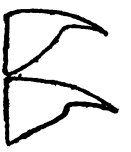


FIG. 16.—HOOKS FROM INTROVERT OF ASPIDOSIPHON SPECIOSUS. ×290.

This species resembles *A. klunzingeri* Selenka and Bülow from the Red Sea.

Genus SIPUNCULUS Linnæus.

This genus includes, in general, large sipunculids, which are found in all seas from the polar to the equatorial regions. The trunk is without papillæ and the introvert without hooks. A flat tentacular fold surrounds the mouth, and its margins in some species are drawn out to form more or less distinct tentacles. The individual tentacles contain a network of blood vessels and not three longitudinal passages as in *Phascolosoma*. A median-dorsal unpaired epithelial tube opens upon the surface of the head immediately behind the tentacular fold, and leads backward to a cerebral sense organ anterior and ventral to the brain. The esophageal connectives do not surround the attachments of the retractor muscles to the head, as in most sipunculids, but lie behind and beneath these attachments. There are usually two contractile tubes of the vascular system. One or

Digitized by Google

more cæca are found on the rectum. Eggs spherical. The prototroch cells of the embryo form an embryonal envelope, which is cast off with the vitellin membrane (*S. nudus*).

SIPUNCULUS NUDUS Linnæus.

This cosmopolitan species occurs in the Mediterranean Sea, on the Atlantic coast of Spain and of France, the North Sea, Panama (Keferstein, 1866), the southern coast of the United States, and also the coast of Malacca (Selenka, 1883) and Loyalty Islands (Shipley, 1899).

A specimen of this species from Key West, Florida, and others from Beaufort, North Carolina, resemble closely those from the English Channel (Roscoff, Finistère), with which I have compared them. Another specimen from Key West, probably of this species, shows some of the peculiarities ascribed to *S. titubans* Selenka and Bülow. That is, its nephridia are attached for nearly one-half their length, whereas in specimens of *S. nudus* (from Roscoff) they are attached for one-fourth to one-fifth their length (as in the other specimen from Key West that I have examined), and are described by Selenka (1883) as free. The specimen appears to be pigmented also, though how much of its present hue may be due to discoloration through desiccation can not be determined. Otherwise it is a typical *S. nudus* with 31–32 longitudinal muscle bands, ventral retractors arising from longitudinal muscles 2–6, dorsal retractors from 7–11. A specimen from Beaufort, North Carolina, likewise has its nephridia attached for two-fifths of their length, though it is not different otherwise from *S. nudus* from the English Channel. Inasmuch as the length of the nephridia varies enormously in the living animal according to conditions of expansion or contraction, undue weight has probably been placed upon this point by Selenka in the determination of species.

SIPUNCULUS TITUBANS Selenka and Bülow.

Although the scope of this paper does not include the description of West Indian sipunculids not also found off the coast of the United States, it may be well to call attention to certain specimens in the National Museum from this region which are probably to be identified as *S. titubans* Selenka and Bülow, but which suggest that this species may be only a local variety of *S. nudus* with no very constantly correlated variations from the widespread form.

Thus a specimen from Jamaica has the nephridia attached through half their length as in *S. titubans*, but has 30 longitudinal muscle bands as in *S. nudus*, not 26 or 27 as in *S. titubans*[1]; specimens from Trinidad have 27–28 longitudinal muscles, an intermediate condition

[1] Selenka and Bülow's original description of *S. titubans* says 26; Fischer's 26 or 27 in front, 32 behind.

Digitized by Google

between *S. nudus* and *S. titubans*, and free nephridia as in *S. nudus*. In all these specimens the four retractors arise in the same zone, the ventral having their origin from longitudinal muscles 2–4, the dorsal from 9–13. (See Selenka's description: 3–5 ventral, 8–13 dorsal. Fischer's, 1894: 3–5 ventral, or 1–5 ventral, and 9–12 dorsal or 8–13 dorsal.) A spindle muscle is present as in *S. nudus*. Nephridia open between longitudinal muscle bands 4–5, as in *S. nudus* and *S. robustus*.

These specimens are unpigmented except at the anterior extremity of the trunk, where the longitudinal ridges are inconspicuously marked for 10 mm. or less with longitudinal rows of small circular bluish-brown spots tending to become confluent. The trunk of the specimen from Jamaica is 65 mm. long. The Trinidad specimens measure: Trunk 110 mm., introvert (narrow papillated part only, not the whole region in front of the anus) about 15 mm. Another: Trunk 70 mm., introvert 10 mm.

It will readily be seen that these specimens suggest that *S. titubans* is a variable form closely resembling *S. nudus* and *S. robustus* Keferstein, from which, in some cases at least, it can hardly be distinguished.

S. titubans was originally described by Selenka and Bülow (1883) from a specimen from Puntarenas on the Pacific coast of Costa Rica. Specimens in the Hamburg Museum described by Fischer (1894) are from St. Jose di Guatemala (Pacific coast of Guatemala) and Madagascar; and a variety of the species from Accra, West Africa, is also described by Fischer. According to Selenka it has been found in the Barbados and is common in the Pacific, especially at Uwea (Wallis Island), Opalu (Samoa), Pelew Islands, Palaos, Amboina, Timor, and Lyly Islands.

SIPUNCULUS PRIAPULOIDES Koren and Danielssen var. AMERICANA, new variety.

Phallosoma priapuloide (LEVINSEN), 1882 and 1883.

Type.—Cat. No. 1379, U.S.N.M. From station No. 2709.

Specimens were taken from the following localities off the coast of the United States:

Station 2530, southeast of Georges Bank, lat. 40° 53′ 30″ N.; long. 66° 24′ W.; 956 fathoms, gray ooze; bottom temperature, 38.4° F.

Station 2709, south of Georges Bank, lat. 40° 07′ N.; long. 67° 54′ W.; 866 fathoms, brown mud.

Station 2217, lat. 39° 47′ 20″ N.; long. 69° 34′ 15″ W.; 924 fathoms, gray mud; temperature at bottom, 38.1° F.

Station 2235, off Cape May and Sandy Hook, lat. 39° 12′ N.; long. 72° 03′ 30″ W.; 707 fathoms, green mud; temperature at bottom, 38.8° F.

Digitized by Google

Station 2018, off Cape Charles, Virginia, lat. 37° 12′ 22″ N.; long. 74° 20′ 04″ W.; 788 fathoms, blue mud; temperature at bottom, 39° F.

Station 2731, off Cape Charles, Virginia, lat. 36° 45′ N.; long 74° 28′ W.; 841 fathoms, gray ooze.

Station 2677, off Charleston, South Carolina, lat. 32° 39′ N.; long. 76° 50′ 30″ W.; 478 fathoms, green mud; bottom temperature, 39.3° F.

An allusion to this form was made by Verrill, 1885, page 23, in his report of the *Albatross* explorations. Among the undetermined species of Gephyrea he mentions "a large strongly sulcated species (fig. 192), taken in 709 to 1,069 fathoms, which is often 3 to 5 inches long and nearly an inch in diameter."

This variety of *S. priapuloides* differs only in minor details from the form that occurs off the coast of Norway which was originally described by Koren and Danielssen (1875 and 1877). Their description has been amplified and corrected at certain points by Théel (1905), who has furnished excellent figures (especially figs. 137, 138, 150). He also gives good reasons for regarding *S. norvegicus* Koren and Danielssen as an immature form of the same species.

Roule (1907) describes a specimen of *S. priapuloides* from off Las Pilones (No. 72 of the *Talisman* expedition) in 882 meters, and four taken in the Bay of Biscay (Golfe de Gascogne) from 800 to 1,000 meters. Roule (p. 95) recognizes that this species is probably identical with *S. norvegicus*, but employs the specific name "*priapuloides*" because the diagnosis of the latter more exactly corresponds with his specimens, and is a descriptive term rather than an inexact geographical designation. Unfortunately, in my opinion, however, he follows Levinsen (1883) in making a separate genus "*Phallosoma*" to contain this species and the probably identical "*norvegicus*."

Sluiter (1900) describes *S. norvegicus* as occurring off the Azores in 1,385 meters.

The American variety was taken as far south as Charleston, South Carolina (station 2677), where it was found at a depth of only 478 fathoms, and its range extends northward at least as far as latitude 41°. The depth at which it was taken varies from 478 to 956, or, according to Verrill, 1,069 fathoms.

The chief difference between the American and the Scandinavian forms is in the number of longitudinal ridges and furrows of the trunk and of the longitudinal muscle bands, which lie beneath the furrows and correspond to them in number. The Scandinavian form is said to have 24 longitudinal muscles, whereas I have found 22 in most specimens, though others have 22 in front and 21 behind, others 23–22, and in one case 23–24. Roule (1907) finds in the specimens from the Bay of Biscay and off Las Pilones that there are 36–38

Digitized by Google

longitudinal bands. In this respect his specimens agree more closely with *S. phalloides* Pallas of the West Indies.

The glans, as the smooth posterior end of the body is called, is not marked off from the rest of the trunk by an annular prepuce-like fold; and Théel also found, as his excellent figure 137 shows, that no fold of this sort occurs in several of the specimens from off the coast of Norway that he examined, hence it is evidently not a characteristic of any morphological importance.

The dorsal retractor muscles in the American variety spring from a single muscle band, the ventral from two, and not in each case from three or four as in the Scandinavian form.

Trunk cylindrical. As shown in Théel's excellent figure it is 110 mm. long and 16 thick; in the contracted specimens from station 2709, south of Georges Bank, it is 75 mm. long and 20 mm. thick. The introvert is distinctly marked off from the trunk, and is of much smaller diameter. It is about one-fourth as long as the trunk. The crown of tentacles consists of 8–12 primary lobes. The surface of the trunk, except at the posterior extremity, is corrugated with 21–24 longitudinal ridges and an equal number of furrows. Underlying each furrow and giving rise to it is a longitudinal muscle band. Each ridge contains a longitudinal canal, which communicates with the cœlom by numerous transverse slits in the layer of circular muscles in the interstices among the longitudinal muscle bands. The posterior extremity of the trunk is smooth, the longitudinal muscle fibers there forming a thin continuous layer rather than separate muscle bands.

No papillæ that are visible to the naked eye are found on the trunk, though very minute, dome-shaped elevations may be detected with a low power of the compound microscope, especially at the posterior extremity. The introvert, except immediately behind the tentacles, is covered with prominent papillæ in the shape of rounded cones, usually slightly longer than thick, and recurved.

The anus is prominent, and lies between one-fifth and one-fourth of the length of the trunk behind the anterior end. The openings of the nephridia lie in front of the anus, about one-half of the distance between the latter and the anterior end of the trunk.

The four retractor muscles all arise from the body wall at about one-fourth of the distance behind the anterior extremity of the trunk, and slightly behind the anus. The origin of the ventral pair is slightly behind that of the dorsal. Each ventral retractor in the variety *americana* is attached to two longitudinal muscle bands; each dorsal to a single longitudinal muscle band.

The intestinal coil is held to the body wall by numerous muscle strands, and the rectum is held by a pair of strong muscles, the attachments of which are close beside those of the dorsal retractors.

Digitized by Google

A loose racemose gland (?) lies upon each of the rectal muscles. A smooth-walled sac-shaped diverticulum of the rectum is situated near its junction with the intestinal coil. A slender columellar or "spindle" muscle is present.

Genus SIPHONOSOMA Spengel, new genus.

Through the kindness of Professor Spengel I am able to make use of this hitherto unpublished[1] generic term, which will include not only the American species *cumanense*, but also those formerly called *Sipunculus vastus*, *arcassonensis*, *boholensis*, and others.[2] Professor Spengel writes that *Siphonosoma* is characterized by its integumental canals, which are not longitudinal as in *S. nudus*, but isolated blind sacs of peculiar form, and which in their construction and arrangement present highly characteristic differences; also by the course of the ventral nerve cord, which is closely applied to the skin throughout the whole introvert, and in its most anterior part is attached to it by a short median mesentery. In the extreme anterior end of this mesentery lies a fine canal opening at the base of the tentacles that runs to the anterior end of the nerve cord, within the substance of which it enters a vesicle that appears to contain a concretion. This organ evidently represents a statocyst provided with a long canal. It occurs also in *Physcosoma*, but not in *Phascolosoma*, so far as investigated. The ciliated nuchal organ is well developed, but the cerebral tube is represented only by a shallow pit. "Other characters are the existence of a thick glandular epithelium in the wall of the rectum, the mode of attachment of the alimentary canal not by numerous threads, but by a few constant 'fixing muscles' as described, for instance, by Selenka in *S. cumanense*, the semilunar form of the nephrostomes, the arrangement of the numerous tentacles, the absence of triangular scale-like papillæ in the anterior part of the introvert, and others."

Type species.—*Siphonosoma australe* (Keferstein).

SIPHONOSOMA CUMANENSE (Keferstein) and var. VITREA (Selenka and Bülow).

Phascolosoma cumanense KEFERSTEIN, 1866.
Sipunculus cumanensis SELENKA, DE MAN, and BÜLOW, 1883.

In the U. S. National Museum there are eight specimens of the type form from Oyster Bay, Florida, taken among "coon oysters," and three of the variety *vitrea* from Key West, from sand along shore.

This species (pl. 60, fig. 14), originally described by Keferstein (1866) as *Phascolosoma cumanense*, in some respects is an intermediate type between that genus and *Sipunculus*. Its slender, separate tentacles are distinctly like those of *Phascolosoma*, and not like those of

[1] A preliminary account of this new genus and of its relations to *Sipunculus* by Professor Spengel was received while the present paper was in press. See LIST OF REFERENCES: Spengel (1912).

[2] Complete list of the species: *australe*, *cumanense*, *vastum*, *boholense*, *edule* Sluiter (not Pallas), *arcassonense*, *amamiense*, *bonhourei*, *rotumanum*, *funafuti*.

Digitized by Google

Sipunculus. On the other hand, its integument and muscles are more like those of *Sipunculus*, though as pointed out to me by Professor Spengel, its integumental canals are isolated blind sacs of peculiar form, not longitudinal vessels as in *Sipunculus nudus*.

S. cumanense is remarkable for the presence of transverse folds of peritoneum that cross the cœlom at regular intervals like the dissepiments of an annelid. In view of this interesting fact, which at least suggests metameric segmentation, and its somewhat generalized structure which combines characteristic features of two genera, a knowledge of its embryology is much to be desired. Its spherical eggs are exceedingly transparent, and this species therefore probably would be very favorable for observations upon the living embryo. I am informed by Professor Spengel that transverse folds of peritoneum like these are not found in the nearest allies of this species, namely, *Siphonosoma vastum*, *arcassonense*, and *boholense*.

The trunk is slender and cylindrical; the introvert about one-fifth to one-third the length of the trunk. The largest specimen from Oyster Bay measures: Trunk 19 cm., introvert 4.5 cm. (well expanded). The specimens are of grayish-brown color, and the body wall is more or less translucent, the typical form (those from Oyster Bay) being *Synapta*-like in appearance, whereas those from Key West identified as the variety *vitrea* have a more gelatinous, translucent appearance. A narrow zone upon the base of the introvert is of a lighter gray, and is covered with epidermal organs of two sizes, the larger ones being placed at somewhat regular intervals, with the smaller irregularly interspersed. The larger have the form of flat circular or elliptical papillæ with a pore or two at the center. The core of the smaller organs rises slightly above the general surface as an exceedingly minute, slender, pointed papilla. The latter are probably sensory, the former glandular or both glandular and sensory. Epidermal organs are also visible with a lens at the posterior extremity of the body. Elsewhere they are extremely minute; 20–21 longitudinal muscle bands are distinctly visible through the body wall, the surface of which is corrugated with furrows corresponding to the muscle bands and with intervening parallel ridges. The longitudinal muscle bands run to the extreme posterior end of the body. The cuticula of the introvert upon contraction is thrown up into narrow plate-like folds, but no hooks are present. There are numerous long, slender tentacles, which are entirely distinct from one another and have the usual longitudinal groove along the oral surface. The nephridiopores are slightly in front of the anus.

The four short retractors arise from the body wall in nearly the same zone, the attachments of the dorsal in some specimens being very slightly in front of those of the ventral. The two ventral retractors are attached to the second and third longitudinal muscle

Digitized by Google

bands, the dorsal to the eighth and ninth, or to the eighth alone. The dorsal retractor of each side is united to the ventral in front, and the esophagus is attached by a peritoneal membrane to the dorsal edge of this united muscle for a distance equal to about half the length of the muscle. The two lateral muscles thus formed by the union of a dorsal and a ventral of each side are quite separate from each other, though they tend to unite in front where each is attached to the esophagus. This species resembles *Sipunculus*, rather than *Phascolosoma*, as regards the position of the esophageal connectives with reference to the retractor muscles. These connectives, as they run dorsad toward the supra-esophageal ganglion, are surrounded by the outer ends of the retractors as in *Sipunculus*, instead of surrounding them as in *Phascolosoma*. The proximal half of each of the two long, slender, brown nephridia is held to the body wall by a fold of peritoneum. Selenka (1883) and Keferstein (1866), however, both describe the nephridia as short, attached, as Selenka found, only by the anterior half. The nephridiopore lies between longitudinal muscles 3 and 4. The dorsal blood vessel (contractile tube) which extends the length of the esophagus, is covered with long, slender evaginations which give it a tufted appearance.

The long intestinal coil consisting of 12–50 turns extends backward to the posterior end of the cœlom, where a long columellar muscle holds it to the body wall. This muscle branches radially and repeatedly near its posterior end, and forms a tree-shaped attachment to the body wall. The intestinal coil is held in position along its entire course, from the base of the ventral retractors backward, by numerous transverse sheets of peritoneum arranged at regular intervals like the dissepiments of an annelid. These sheets are attached laterally, but not dorsally, to the body wall at the right and left of the intestine, and stretch across the cœlom vertically. They are not attached, as far as I can discover, to the intestinal coil. Four muscle strands attach the rectum to the body wall, namely, (1) the anterior end of the columellar muscle, which is attached to the body wall in front of the anus and extends backward through the entire length of the intestinal coil, (2) two pairs of branches of the columellar muscle, one pair of which is attached to the body wall in front of the right-dorsal retractors, the other immediately behind or between the attachments of the ventral pair to the body wall. The anal end of the rectum, also, in the variety *vitrea*, is held closely to the body wall by numerous folds of peritoneum and fine fibers extending over 10 or 12 longitudinal muscle bands. A prominent cæcum is situated on the left side of the posterior end (beginning) of the rectum.

The body wall in the small specimens from Key West is more translucent than in the larger individuals from Oyster Bay, Florida, so that I have identified the former as of the variety *vitrea* Selenka

Digitized by Google

and Bülow. The length of the trunk in the largest of these specimens is about 85 mm., diameter 6 mm.; the length of the smallest 52 mm., with an introvert of 12 mm. The trunk of another is 58 mm. long. It is probable that the differences between the two "varieties" is due to the direct action of surrounding conditions and not to inheritance.

LIST OF REFERENCES.

ANDREWS, E. A. Notes on the Anatomy of Sipunculus Gouldii Pourtalès. Stud. Biol. Lab. Johns Hopkins Univ., vol. 4, 1890, pp. 384–430, pls. 44–47.

AUGENER, H. Westindische Polychaeten. *Blake* Reports 42. Bull. Mus. Comp. Zool., vol. 43, 1906, No. 4 [pp. 193–196 and pl. 8 refer to Sipunculids].

BAIRD, W. Monograph of the Species of worms belonging to the subclass Gephyreæ. Proc. Zool. Soc. London, 1868, pp. 77–114, pls. 9–11.

DANIELSSEN, D. C., and KOREN, J. The Norwegian North Atlantic Expedition, 1876–78, Zoology, Gephyrea. Christiania, 1881.

DIESING, C. M. System Helminthum, vols. 1, 2, 1850–51. Vidobonæ.

———— Revision der Rhyngodeen. Sitzungsber. kais. Akad. Wien. Math.-naturw. Classe, 1859.

GEROULD, J. H. The Development of Phascolosoma. Zool. Jahrb., Abth. Anat., vol. 23, 1906, Heft 1, pp. 77–162, pls. 4–11.

———— A Comparison of the Cephalic Organs in Certain Sipunculids. Science, n. s., vol. 27, No. 691, March 27, 1908.

GRUBE, E., and ÖRSTED, A. S. Annulata Örstediana. Videnskabelige Meddelelser fra den naturhist. Forening i Kjöbenhavn. Aar 1858. Kjöbenhavn, 1859.

KEFERSTEIN, W. Beiträge zur anatomischen und systematischen Kenntniss der Sipunculiden. Nachr. kön. Ges. Göttingen, 1865, No. 7, pp. 189–209.

———— Beiträge zur anatomischen und systematischen Kenntniss der Sipunculiden. Zeitschr. wiss. Zool. vol. 15, 1865.

———— Untersuchungen ueber einige amerikanische Sipunculiden. Nachr. kön. Ges. Göttingen, 1866, No. 14, pp. 1–15.

KOREN and DANIELSSEN. Fauna littoralis Norvegiae, 3die Hefte, med 16 Tavler. Bergen, 1877.

———— Fra den norske Nordhavsexpedition (Gephyreer). Mit 1 Taf. Nyt Mag. Nat. Vet., vol. 26, 1880.

LEVINSEN, G. M. R. Systematisk geographisk oversigt over de nordiske Annulata, Gephyrea... Vid. Medd. fra den naturhist. Foren. Kjöbenhavn, 1882, 1883.

MOEBIUS, K. Jahresber. Kommission wiss. Untersuchung d. deutschen Meere in Kiel, f. d. Jahre, 1872, 1873. V. Vermes. Berlin, 1875.

PAUL, G. Ueber Petalostoma minutum Kef. und verwandte Arten. Zool. Jahrb., Abth. Anat., vol. 29, 1909, pp. 1–50, pls. 1, 2.

POURTALÈS, L. F. DE. On the Gephyrea of the Atlantic Coast of the United States. Proc. Amer. Ass. Adv. Sci., 5th Meeting, 1851, pp. 39–42.

QUATREFAGES, M. A. DE. Histoire naturelle des Annélés marins et d'eau douce, vol. 2. Paris, 1865.

ROULE, L. Annélides et Géphyriens. Expéditions scientifiques du *Travailleur* et du *Talisman*, vol. 8, 1907, pp. 1–102, pls. 1–10. Paris.

SARS, M. Nyt Mag. Naturvid., vol. 6. Christiania, 1851.

SELENKA, E., DE MAN, J. G., and BÜLOW, C. Die Sipunculiden. Reisen im Archipel der Philippinen von Dr. C. Semper. 2te Theil, 4te Bd., 1 Abth. Wiesbaden, 1883.

SELENKA,, E. Report on the Gephyrea. Scientific Results of the Voyage of H. M. S. *Challenger*, 1873–76. Zoology, vol. 13, pt. 36, pp. 1–25, pls. 1–4, 1885.

Digitized by Google

SELENKA, E. Die Sipunculiden-Gattung Phymosoma. Zool. Anz., vol. 20, No. 546, p. 460, 1897.

SLUITER, C. PH. Géphyriens (Sipunculides et Echiurides) provenant des campagnes de *l'Hirondelle* et de la *Princesse Alice*, 1886–1897. Resultats des Campagnes Scientifiques par Albert 1er, Prince de Monaco. Fascicule XV, pp. 1–29, 3 pls. Monaco, 1900.

SPENGEL, J. W. Einige Organisationsverhältnisse von Sipunculusarten und ihre Bedeutung für die Systematik dieser Tiere. Verh. d. Deutsch. Zool. Gesellsch-22sten Jahresversammlung zu Halle, 1912, pp. 261–272.

THÉEL, HJ. Recherches sur le Phascolion strombi Mont. Kongl. Svenska Vet. Akad. Handl., vol. 14, No. 2. Stockholm, 1875.

———— Northern and Arctic Invertebrates in the Swedish State Museum (Riks, museum). I. Sipunculids. Kongl. Svenska Vet. Akad. Handl., vol. 39, No. 1. pp. 1–102, 15 pls. Uppsala, 1905.

VERRILL, A. E. Results of recent Dredging Expeditions on the Coast of New England. Amer. Jour. Sci. and Arts, ser. 3, vol. 5, 1873, p. 99.

———— Report upon the Invertebrate Animals of Vineyard Sound and Adjacent Waters. Rept. U. S. Comm. Fish and Fisheries, pt. 1, 1871–72, pp. 295–778, pls. 1–38. Washington, 1873.

———— Explorations of Casco Bay by the U. S. F. C. in 1873. Proc. Amer. Ass. Adv. Sci., Salem, 1874, pp. 340–395, pls. 1–6.

———— Results of the Explorations made by the Steamer *Albatross*, off the northern coast of the United States in 1883. Rept. U. S. Comm. Fish and Fisheries, pt.11, pp. 503–727, pls. 1–44. Washington, 1885.

EXPLANATION OF PLATES.

PLATE 58.

FIG. 1. *Phascolosoma margaritaceum* (Sars). x 2.
2. *Phascolosoma cylindratum* Keferstein. x 2.
3. *Phascolosoma procerum* Mœbius. Nat. size.
4. *Phascolosoma eremita* (Sars). x 6.
5. *Phascolosoma verrillii* Gerould. x 2½.

PLATE 59.

FIG. 6. *Phascolosoma cinctum*, new species. x 13½.
7. *Phascolosoma verrillii* Gerould. x 24½. Drawn from a live young specimen, showing the peculiar characteristic of the species under adverse conditions of partially sloughing the cuticula at the extremity of the introvert. Length of the individual expanded, 7–8 mm.; and 5 mm. in ordinary contraction. Color, light brown; cœlomic corpuscles purple by transmitted light; *oc.*, pigmented eye.
8. Dissection of *Phascolosoma procerum* Mœbius. x 2. *go*, reproductive organs; *neph.*, nephridium; *n. v.*, ventral nerve cord; *oe.*, esophagus; *tb.*, *Pol.*, Polian tube.
9. *Dendrostoma alutaceum* Grube. x 3.

PLATE 60.

FIG. 10. Tube inhabited by *Phascolion strombi* (Montagu). x 2. From station 210, off Cape Ann.
11. Papilla from base of introvert of *Phascolion strombi*. x 385.
12. Head and tentacles of *Phascolion strombi*. x 30½.
13. Surface view of *Phascolion strombi* var. *lævis*. x 8.
14. *Siphonosoma cumanense* (Keferstein), from Florida. Nat. size.

Digitized by Google

PLATE 61.

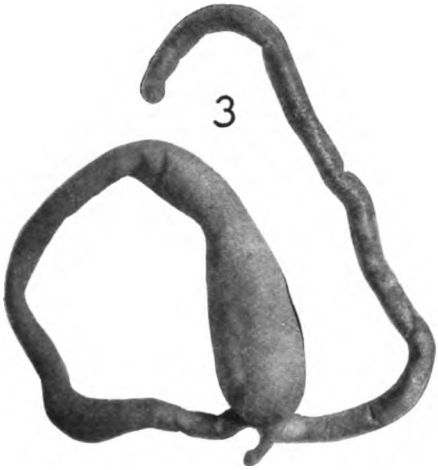
FIG. 15. Head of *Physcosoma capitatum*. x 46.
16. Surface view of *Phycosoma capitatum*. x 6⅛. From station 2029.
17. Surface view of *Aspidosiphon parvulus*. x 17½.

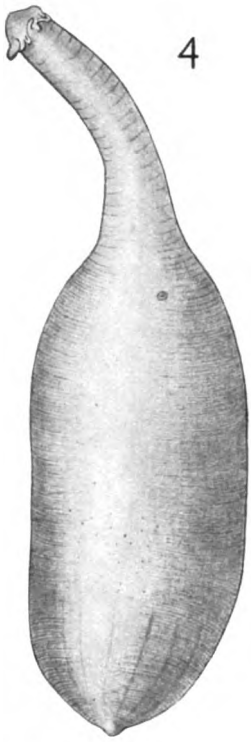
PLATE 62.

FIG. 18. *Phycosoma varians* Keferstein. x 2.
19. *Phycosoma antillarum* Grube and Örsted. A large contracted specimen. x 2.
20. *Phycosoma antillarum*, an expanded specimen. x 2.
21. *Phycosoma capitatum*, new species. x 2¾.
22. *Aspidosiphon speciosus*, new species. x 2.

Digitized by Google

Digitized by Google





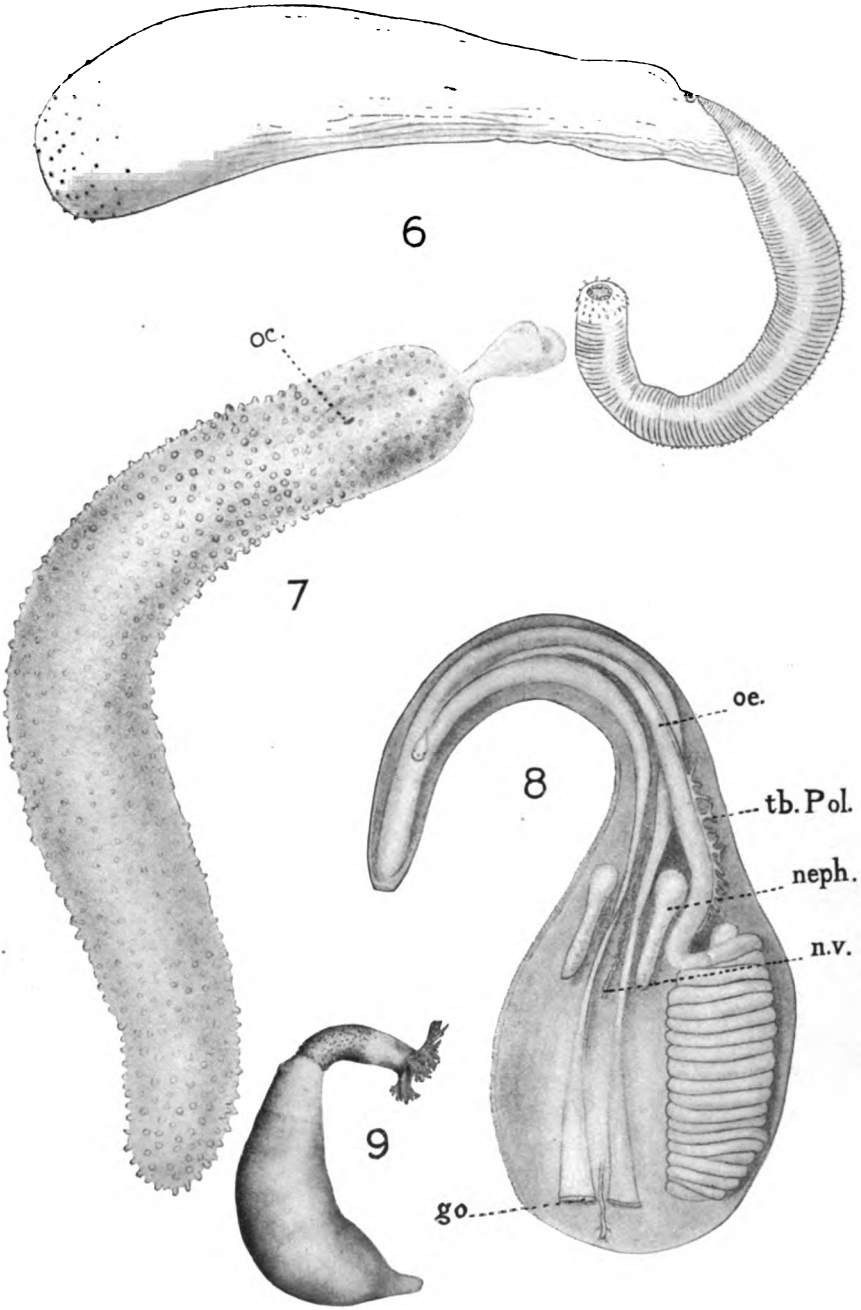
2

SIPUNCULIDS OF EASTERN COAST OF NORTH AMERICA.

FOR EXPLANATION OF PLATE SEE PAGE 436.

Digitized by Google

Digitized by Google



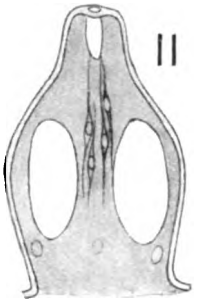
SIPUNCULIDS OF EASTERN COAST OF NORTH AMERICA.

FOR EXPLANATION OF PLATE SEE PAGE 436.

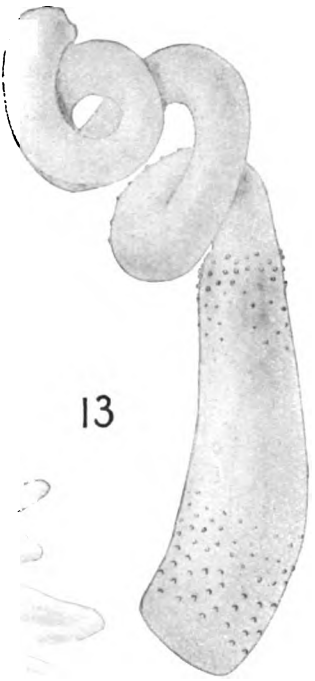
Digitized by Google

Digitized by Google

10

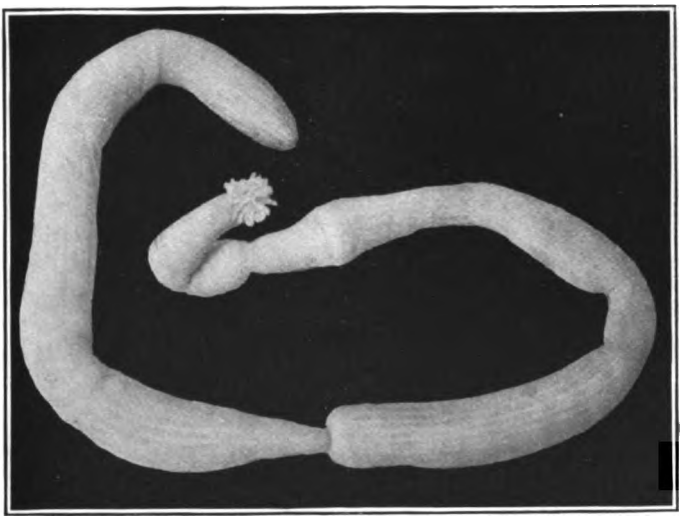


11



13

12



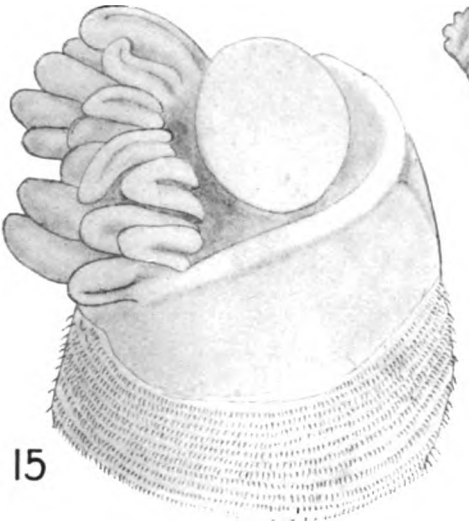
14

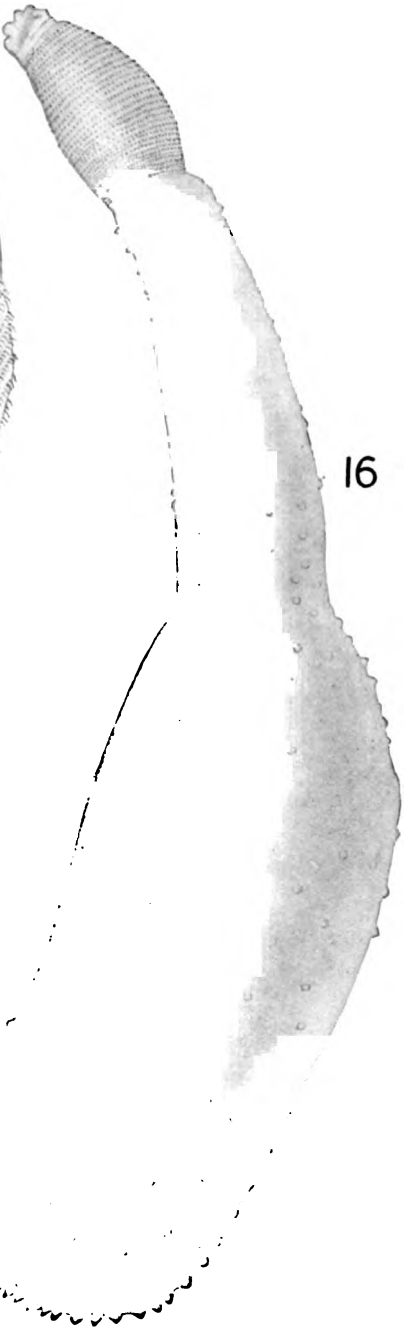
SIPUNCULIDS OF EASTERN COAST OF NORTH AMERICA.

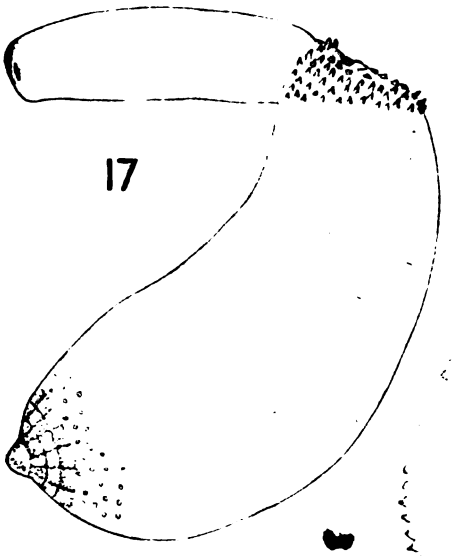
FOR EXPLANATION OF PLATE SEE PAGE 436.

Digitized by Google

Digitized by Google





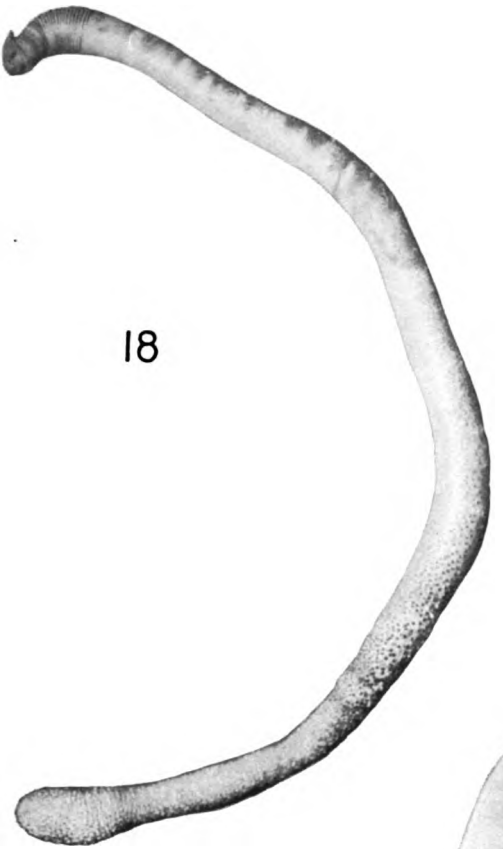


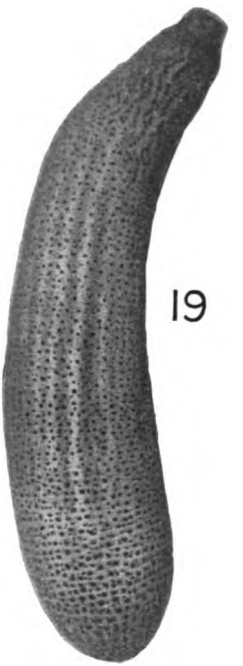
SIPUNCULIDS OF EASTERN COAST OF NORTH AMERICA.

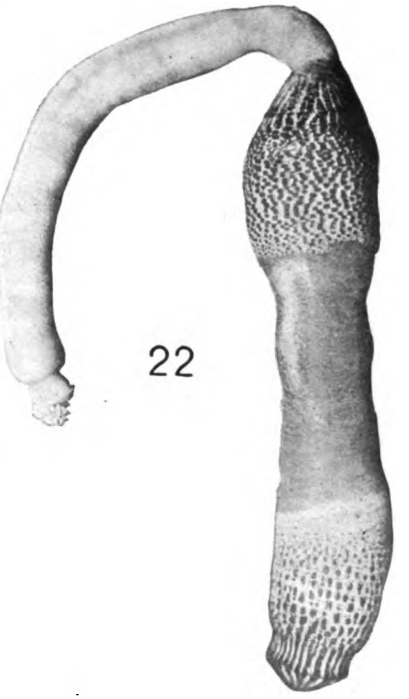
FOR EXPLANATION OF PLATE SEE PAGE 437.

Digitized by Google

Digitized by Google







SIPUNCULIDS OF EASTERN COAST OF NORTH AMERICA.

FOR EXPLANATION OF PLATE SEE PAGE 437.

Digitized by Google

Digitized by Google

RESULTS OF THE YALE PERUVIAN EXPEDITION OF 1911. HYMENOPTERA, SUPERFAMILIES VESPOIDEA AND SPHECOIDEA.

By S. A. ROHWER,

Of the Bureau of Entomology, United States Department of Agriculture.

The Hymenoptera belonging to the superfamilies Vespoidea and Sphecoidea obtained by the Yale Peruvian Expedition were collected in the following localities: Panama Canal Zone, Panama; San Miguel, Peru; Santa Ana, Peru; Ollantaytambo, Peru; Arequipa, Peru; Desert of Salavery, Peru; Cuzco, Peru. The following five southeastern Peruvian localities, Paltaybamba, Tortontoy, Huadquina, Tincochaca, and Pampaconas River can only be found in some of the most recent atlases, but the Pampaconas River is a stream lying between the Urubamba and Apurimac Rivers.

Of this lot of Hymenoptera referred to, consisting of 26 species, 14 are described as new, 11 are determined as heretofore described species, and 1 which belongs to the genus *Pepsis* has not been determined. Nearly all of those species which were determined as having been heretofore described belong to the family Vespidæ, and most of these have a wide distribution throughout the entire Neotropical region. The insects belonging to the family Eumenidæ are all related to insects found in the high mountains of the Andes, and more especially with the insects belonging to the Chilean fauna. Insects of the superfamily Sphecoidea show no special affinities with any region, in fact this may be said for many of them although a few of the species have their allies either in insects belonging to the Chilean fauna or insects which belong to the high mountain fauna of Guatemala, etc. But few Hymenoptera have ever been described from Peru and it is not surprising that more than half of those submitted should turn out to be new species.

In the case of the two species of Mutillids described it may be possible that they have been described by some of the older authors, but no description could be found to apply well enough to make their determination certain. The two Mutillids are referred to the genus *Sphærophthalma* Blake where they run in Andre's synopsis of the

Digitized by Google

genera of Mutillidæ, but according to the genotype of *Sphærophthalma* these insects will have to be separated into a different genus, but until it is possible to review the genera of the world they have been left in *Sphærophthalma* so as to agree with the latest revision of these insects.

Superfamily VESPOIDEA.

Family PSAMMOCHARIDÆ.

Genus PEPSIS Fabricius.

A male collected at Huadquina, Peru, at an altitude of 5,000 feet, July 25, 1911. This species may be described, although I can not make it agree with any of the numerous descriptions, and as the genus is in a chaotic state it is inadvisable to describe it at present.

Genus CRYPTOCHEILUS Panzer.

CRYPTOCHEILUS PERUVIANUS, new species.

This species closely resembles *fulvicornis*, but may easily be separated by the lateral aspect of the propodeum being striate.

Female.—Length 15 mm. Anterior margin of the clypeus broadly, arcuately emarginate, the surface closely granular; the area around the antennæ subdepressed; frontal impressed line strong, incomplete; eyes slightly converging toward the vertex; malar space obsolete; postocellar line distinctly shorter than the ocellocular line; head opaque, finely granular; antennæ normal, third joint distinctly longer than the fourth; posterior margin of the pronotum angulately emarginate; dorsal aspect of the propodeum finely granular, the posterior face and the sides strongly transversely striate; posterior face oblique, not sharply separated from the dorsal aspect; dorsal aspect of the propodeum with a few erect, black hairs; tarsal comb wanting; legs rather feebly spined, hind legs rather long, slender; abdomen normal, second ventral segment with two tubercules, the apical ventral segment broadly arcuate; transverse median of the fore wings its own length beyond the basal vein; the third cubital cell on the radius slightly shorter than the second; the second and first transverse cubiti oblique, nearly parallel, the third transverse cubitus strongly curved above the middle so the third cubital cell is not half as wide at the top as at the bottom; second recurrent vein strongly curved, received distinctly basad of the middle of the cell. Black; antennæ beyond the second joint fulvous; wings black with a faint purplish tinge at the base, slightly brownish at the apex; venation the color of the wings; head and thorax with long black hair; apex of the abdomen with long black hair.

Santa Ana, Peru. Described from one female collected August 3, 1911, at an altitude of 3,000 feet.

Type.—Cat. No. 15109, U.S.N.M.

Digitized by Google

Genus PSAMMOCHARES Latreille.

PSAMMOCHARES (PSAMMOCHARES) DICHROMORPHA, new species.

Readily distinguished by the bluish head and thorax and rufous abdomen.

Female.—Length 12 mm. Stout. Anterior margin of the clypeus very slightly incurved, the lateral angles rounded; frontal impressed line strong, complete; eyes slightly converging toward the vertex; malar space nearly obsolete; ocelli in a low triangle; postocellar line not quite twice the length of the intraocellar line; antennæ of the usual type, third joint distinctly longer than the fourth; posterior margin of the pronotum angulately emarginate; scutellum flat; dorsal aspect of the propodeum with distinct median furrow, the posterior aspect oblique and not sharply separated from the dorsal aspect; femora rather robust; tarsal comb present; legs rather strongly spined, the apical joint of the hind tarsi spinose beneath; longer calcarium of the posterior tibiæ not quite half the length of the post-basitarsis; claws not strongly curved, with an erect median tooth about the middle; transverse median vein of the fore wings nearly its own length beyond the basal; third cubital cell on the radius distinctly longer than the second on the same vein; first transverse cubitus strongly curved, second cubital cell being much narrowed above; third cubital cell receiving the second recurrent vein distinctly before the middle; the third transverse cubitus oblique so the third cubital cell is narrowed above; transverse median of the hind wings slightly before the cubitus; abdomen cylindrical, normal type; pygidium obtusely rounded apically; apical ventral segments truncate; head and thorax black, at least black in the places where the pubescence is wanting but very densely, closely clothed with an appressed dark blue pubescence which conceals the color of the thorax and its sculpture; legs and antennæ black; the femora with appressed pubescence like the thorax; abdomen entirely rufous with a fine, appressed, silvery pubescence; wings dusky hyaline; venation black.

Cuzco, Peru. Described from one female collected July 4, 1911, at an altitude of 11,500 feet.

Type.—Cat. No. 15108, U.S.N.M.

Genus ARACHNOPHROCTONUS Ashmead.

In Banks' generic synopsis for the North American Psammocharinæ the genus *Arachnophroctonus* is placed in the group which has erect hair on the dorsal aspect of the propodeum. According to the type of the genus and all the species in the collection of the United States National Museum there is no erect hair on the dorsal aspect of the propodeum, and the genus, according to Banks' arrangement, will

Digitized by Google

fall near *Sericopompilus*, from which it may be separated by having the hind tarsi spined, especially the apical joint beneath; the propodeal spiracle opening posteriorly; the abdomen cylindrical, the first segment subequal in length with the second and not narrowed anteriorly; the dorsal aspect of the propodeum with a median impressed line, more distinct basally; the posterior margin of the pronotum with a longitudinal impressed median line; and the species largely ferruginous. In some of the Neotropical species of the genus *Arachnophroctonus* the dorsal lateral angles of the pronotum are strongly tuberculate. This tuberculation is much stronger in *tuberculatus* Smith.

ARACHNOPHROCTONUS XANTHOPTERUS, new species.

This species is related to *tuberculatus* (Smith), but may easily be separated by not having the wings banded with fuscous. *Rubiginosus* Taschenberg may belong to this genus, but the black on the abdomen will readily separate *xanthopterus* from Taschenberg's species. The yellow wings readily separate *xanthopterus* from the Nearctic *ferrugineus*.

Female.—Length 14 mm. Clypeus gently convex, the anterior margin nearly truncate; supraclypeal area flat; above and between the bases of the antennæ is a large rounded tubercule; impressed line line-like, complete; ocelli in a low triangle; postocellar line distinctly longer than the ocellocular line; inner margins of the eyes curved, closer together at the vertex than at the clypeus; malar space short but present; antennæ tapering apically, the third joint nearly twice as long as the fourth; posterior margin of the pronotum broadly, arcuately emarginate, well developed laterally; metanotum with rather long, dense, gray hair; dorsal, posterior lateral angles of the propodeum strongly tuberculate; dorsal middle of the propodeum strongly convex; third cubital cell on the radius subequal in length with the distance between the third transverse cubitus and the costal margin of the radius; second recurrent vein received about the middle of the third cubital cell, first recurrent vein received about the apical fifth of the second cubital cell; transverse median of the fore wings interstitial with the basal vein; transverse median of the hind wings interstitial with the cubitus; legs rather strongly spined, tarsal claws with an erect inner tooth, tarsal comb well defined; abdomen normal, the apical dorsal segment broadly rounded apically. Ferruginous; four apical joints of the antennæ, base of the first abdominal segment, narrow apical margin of the first and second tergites and most of the thoracic sutures black; wings strongly yellowish, apices dusky; venation the color of the wings; dorsal aspect of the thorax and the mesepisternum with very fine, appressed golden pubescence; head with rather sparse, erect, golden hair.

Digitized by Google

San Miguel, Peru. Described from one female collected September 1, 1911, at an altitude of 6,000 feet.

Type.—Cat. No. 15107, U.S.N.M.

Genus CEROPALES Latreille.

CEROPALES BASIRUFUS, new species.

This may easily be distinguished by the pale markings of the head and thorax and by having the basal segment of the abdomen rufous.

Female.—Length 7 mm. Anterior margin of the clypeus nearly truncate; eyes large, strongly converging below, separated at the clypeus by the distance which is subequal in length with the second and third antennal joints; front with strong distinct punctures on a granular surface, with a median longitudinal fovea; vertex shining with rather small, poorly defined punctures on a feebly granular surface; anterior ocellus larger than the lateral one; the postocellar line slightly shorter than the ocellocular line; antennæ very slightly thickening apically, the joints poorly defined, the third and fourth subequal in length; the anterior lateral margin of the pronotum tuberculate; pronotum, mesoscutum and scutellum with rather large distinct punctures; scutellum convex; mesepisternum finely granular; sides of the propodeum and the metapleuræ finely granular; metanotum strongly raised, its posterior face truncate; propodeum finely granular with a V-shaped fovea at the base, a faint impressed line from fovea to the ventral margin of the posterior face; legs very feebly spined; third cubital cell on the radius strongly narrowed so the distance between the second and third transverse cubiti is but little greater than the distance between the second transverse cubitus and the second recurrent vein; third cubital cell on the cubitus subequal in length with the second; first transverse cubitus strongly bent above the middle, second transverse cubitus straight; second recurrent vein in the basal third of the third cubital cell; first recurrent vein in the apical third of the second cubital cell; transverse median and basal vein interstitial; transverse median of the hind wings well before the cubitus; abdomen normal, impunctate. Black; clypeus, labrum except the median spot, head below the antennæ, inner margin of the eyes almost to the vertex, posterior margin of the eyes almost to the vertex, scape and pedicellum beneath, tubercule of the pronotum, narrow basal margin of the metanotum, spot on the scutellum, spot on the metanotum, four anterior coxæ, four anterior tibiæ beneath (that of the second not broadly), the apical margins of the second to fifth tergites inclusive, more broadly, so on the fifth, and small spots on the second to fourth sternites inclusive *yellowish white;* legs except the four anterior coxæ which are black and the basal segment of the abdomen and the venter rufous; mesepisternum, propodeum, coxæ, and face with appressed

Digitized by Google

silvery hair; abdomen with very fine, appressed pile; wings hyaline, extreme apices dusky; venation dark brown. In the paratype the markings are more yellow and the rufous of the first abdominal segment extends to the base of the second, the flagellum except the apical two joints is yellowish beneath.

Santa Ana, Peru. Two females collected August 3, 1911, at an altitude of 3,000 feet.

Type.—Cat. No. 15110, U.S.N.M.

Family CHRYSIDIDÆ.

Genus CHRYSIS Linnæus.

CHRYSIS (TETRACHRYSIS) RUGOSA, new species.

Allied to *carinata* Guérin, but the scutal furrows curve anteriorly and are not well defined, the median depression on the first abdominal segment is shallower; the conformation of the propodium is different; and it is of smaller size.

Female.—Length 9 mm. Anterior margin of the clypeus truncate medianly, the surface sparsely punctured; malar space about one and one-half times as long as the width of mandible at base; frontal carina strong, lower lateral ends of the carinæ distinctly below the middle of the eyes, the truncate median portion of the carinæ distinctly above the middle of the eyes; facial basin striato-punctate, the striation predominating and oblique; head closely punctured with very large punctures; ocelli simple, the postocellar line about one-third longer than the ocelloccipital line but distinctly shorter than the ocellocular line; orbital carina strong but not extending as high as the superior orbits; antennæ rather stout, the third joint about one-third longer than the fourth; pronotum shorter than the cephal-caudad length of the head; scutal furrows diverging anteriorly, poorly defined; the thorax above with very large close punctures giving it the appearance of being reticulate; mesepisternum sculptured like the dorsal part of the thorax; posterior aspect of the propodeum with a broad, truncate V-shaped depression which is bounded by carinæ; ventrally this depression is deeper and has two spoon-like foveæ; in the middle the depression is reticulate, laterally it is striate; legs normal; radial cell open at the apex; first abdominal segment sculptured like the mesoscutum with three longitudinal depressions on the basal margin, the lateral two being deeper than the median; second and the base of the third abdominal segments with distinct, rather large, well defined punctures, the second and third segments with a median carina, third abdominal segment very like *carinata* as figured by Mocsary on plate 2, figure 43, of his monograph; supra-apical foveæ of the third segment elongate, well defined, deep, 11 in number. Metallic green; flagellum beyond the first

Digitized by Google

joint and tarsi black; wings hyaline, very faintly dusky; venation pale brown; insect rather densely clothed with long white hair.

Ollantaytambo, Peru. Two females collected July 20, 1911, at an altitude of 9,000 feet.

Type.—Cat. No. 15100, U.S.N.M.

Family EUMENIDÆ.

Genus HYPODYNERUS Saussure.

HYPODYNERUS VESTITUS Saussure.

One male collected at Cuzco, Peru, at an altitude of 11,500 feet, July 9, 1911.

HYPODYNERUS TAPIENSIS Saussure.

One female collected at Ollantaytambo, Peru, at an altitude of 9,000 feet, July 21, 1911.

HYPODYNERUS NIGRICORNIS, new species.

Related to *Hypodynerus huancabambæ* Schrottky, but that species has red tegulæ, a black pronotum, and a different clypeus.

Female.—Length 15 mm. Anterior margin of the clypeus very broadly, arcuately emarginate, the surface finely granular; supraclypeal area convex, broader above; head above the antennæ closely, sometimes confluently, punctured; ocelli in a curved line; postocellar line longer than the ocellocular line; antennæ stout, the third joint thickening apically and longer than the fourth and fifth combined; anterior margin of the pronotum carinate; thorax closely, confluently punctured; posterior margin of the metanotum gently rounding; the posterior face of the propodeum with heptagonal area defined by weak carinæ; this area is striato-reticulate with a strong median carina, sides of propodeum finely, transversely striato-reticulate; legs slender, normal; abdomen shining, very finely punctured, the basal segment in the apical middle with a longitudinal depression, the second ventral segment truncate anteriorly. Black; anterior margin of the pronotum, narrow apical margin of the first and second tergites and the second sternite yellow; legs below the bases of the femora rufous; head and thorax clothed with long black hair; wings uniformly dark brown with a purplish tinge; venation black.

Cuzco, Peru. Described from three females, two collected July 7 (one type) and one collected July 4, 1911, at an altitude of 11,500 feet.

Type.—Cat. No. 15105, U.S.N.M.

Genus ODYNERUS Latreille.

ODYNERUS (STENODYNERUS) HIRSUTULUS, new species.

This species runs in Saussure's Synopsis of the North American Vespidæ to *similis* Smith, but that species has different colored wings and is otherwise different.

Digitized by Google

Female.—Length 9 mm. Anterior margin of the clypeus broadly, gently, arcuately emarginate, the lobes subdentate, obtuse; the surface of the clypeus confluently punctured; head with rather large, uniform, distinct punctures; ocelli in a low triangle; postocellar line distinctly shorter than the ocellocular line; posterior orbits simple; flagellum thickening apically, the basal joint subequal in length with the third and fourth beneath, but shorter above; anterior margin of the pronotum rounded, not divided laterally; thorax punctured like the head except that the mesepisternum is more closely so; metanotum rounded; propodeum with a defined area, posteriorly with a strong median carina, which is divided above, leaving a fovea just below the metanotum; abdomen opaque, finely reticulate, the first segment fully three times as wide as long, the second segment slightly wider than long; second ventral segment truncate anteriorly; legs normal. Black; spot on the apex of the clypeus, a small spot between the antennæ and eye, a small spot on the vertex behind the eye, a narrow line on the pronotum, narrow margin of the tegula, tergites, one to five inclusive, margins of sternites, two to six inclusive, yellow; head, thorax, and first abdominal segment clothed with long, sparse, yellowish hair; wings strongly dusky; venation black.

Tincochaca, Peru. Female collected August 8, 1911, at an altitude of 7,000 feet.

Type.—Cat. No. 15106, U.S.N.M.

Family VESPIDÆ.

Genus POLISTES Latreille.

POLISTES CANADENSIS Linnæus.

One worker collected at Panama.

POLISTES CANADENSIS variety INFUSCATUS Lepeletier.

Three workers collected at Huadquina, Peru, at an altitude of 5,000 feet. Collected July 26, 30, 1911.

POLISTES VERSICOLOR (Olivier).

Three workers collected at Arequipa, Peru, at an altitude of 7,600 feet, June 28, 1911. These represent a variety with the ferruginous replaced by black.

Genus POLYBIA Lepeletier.

POLYBIA OCCIDENTALIS Olivier.

One male collected at San Miguel, Peru, at an altitude of 6,000 feet, September 1, 1911.

Digitized by Google

POLYBIA BELIZENSIS Cameron.

Two workers collected at Santa Ana, Peru, at an altitude of 3,000 feet, August 3, 1911. Two workers collected at Huadquina at an altitude of 5,000 feet, August 1, 1911.

Genus STELOPOLYBIA Ducke.

STELOPOLYBIA MERIDIONALIS (von Ihering).

One worker collected at the Pampaconas River, Peru, August, 1911.

STELOPOLYBIA SULFUREOFASCIATA Ducke.

One worker collected at San Miguel, Peru, at an altitude of 6,000 feet, September 1, 1911. Four workers collected at Tincochaca, Peru, at an altitude of 7,000 feet, August 8–10, 1911. Two workers from Paltaybamba, Peru, at an altitude of 5,000 feet, August 6, 7, 1911. One worker collected at Tontontoy, Peru, at an altitude of 7,000 feet, July 23, 1911.

Genus NECTARINA Shuckard.

NECTARINA BILINEOLATA variety MŒBIANA Saussure.

Two workers collected at the Pampaconos River, Peru, August, 1911.

Family THYNNIDÆ.

Genus PSEUDELAPHROPTERA Ashmead.

PSEUDELAPHROPTERA (?) MAURA, new species.

This species runs in Turner's table to the genera of Thynnidæ to the genus *Pseudelaphroptera* Ashmead, but there are a number of differences between this species and the genotype of the genus in question, so it is doubtful whether it belongs to this genus. It may when its female is known be a new genus. The following species is asily separated from all other species of the genus *Pseudelaphroptera* by its black color. Superficially it resembles closely *Elaphroptera atrata*.

Male.—Length 12 mm. Antennæ, length 6 mm. Clypeus strongly convex, apically carinate; the anterior margin raised with very slight shallow median notch; dorsal surface of the clypeus finely punctured; inner margins of the eyes slightly diverging toward the clypeus; malar space obsolete; front with rather large sparse punctures, the vertex has the punctures finer and closer; ocelliin nearly an equilateral triangle; latrad of each lateral ocellus is a shallow fovea; antennæ slender, filiform, the apical joints crenulate, third and fourth joints subequal in length; anterior margin of the pronotum carinate but not divided longitudinally; scutal furrows deep, slightly converging posteriorly; mesoscutum shining with sparse, distinct punctures;

Digitized by Google

scutellum depressed anteriorly, the depression foveolate, the larger and basal portion of the scutellum convex, shining, at the top with a median fovea; mesepisternum sculptured like the mescutellum, anteriorly the mesepisternum is very strongly depressed; propodeum oblique, depressed, shining, sparsely punctured; propodeal spiracle elongate, oval in outline; legs normal; third cubital cell on the radius distinctly longer than the first and second combined, on the cubitus its length is but little shorter than that of the first and second cubital cells; second recurrent vein received distinctly basad of the middle of the third cubital cell; first recurrent vein received apicad of the middle of the second cubital cell; transverse median and basal veins interstitial; abdomen slender, depressed, flat ventrally, segments not constricted, shining, impunctate; hypopygidium tridentate apically, the median tooth broad, pointed apically, triangulate, lateral teeth very broad and obtusely rounded apically. Black; head, thorax, legs and sternum densely clothed with long white hair which on the thorax is slightly reddish; wings yellowish, hyaline; venation pale brown.

Tincochaca, Peru. One male collected August 9, 1911, at an altitude of 7,000 feet.

Type.—Cat. No. 15102, U.S.N.M.

Family SCOLIIDÆ.

Genus CAMPSOMERIS Lepeletier.

CAMPSOMERIS (CAMPSOMERIS) SIMILARIS, new species.

Readily separated from *argenteopilosa* Cameron, described from the same region, by the absence of black hair. This species resembles the Nearctic *fossulana* but the abdomen lacks the bluish tinge, the bands on the first and second tergites are broader and the pronotum is yellow posteriorly. In Saussure and Sichel's Catalogue of the species of this genus, this species seems to fall in Group 5, Division 3, and is apparently closely to *servillei* Guérin but it does not agree with the description of that insect.

Male.—Length 14 mm. Anterior margin of the clypeus truncate, the distance between the eyes at the clypeus less than the length of the third and fourth antennal joints; supraclypeal area convex, punctured dorsally; front with close distinct punctures; the emargination of the eyes and the head above shining, with a few widely scattered, distinct punctures; postocellar line distinctly longer than the ocellocular line; antennæ nearly filiform, the third and fourth joints subequal; mesoscutum dull with a few large, well separated punctures; scutellum and metanotum similar; just inside each tegula is a deep furrow which extends almost to a line drawn tangent to the anterior margin of the tegulæ; mesepisternum sculptured like the mesoscutum;

Digitized by Google

metapleuræ and sides of the propodeum shining, practically impunctate dorsal aspect of the propodeum short, not sharply separated from the posterior aspect, surface with a number of large, distinct, close punctures; legs normal; the distance between the two recurrent veins subequal in length with the distance between the first and second transverse cubiti on the radius, transverse median almost its own length beyond the basal vein; abdomen normal; pygidium broadly rounded apically, the lateral spines a little shorter than the median; narrow apical margins of the genitalia stipes broadly, rounded more strongly so laterally, the inner margin of the stipes concave, the outer margin convex. Black; mandibles except apices, clypeus except large median spot, spot on the proepisternum, the inner posterior margins of the pronotum, spot on the tegula, a band on the scutellum and metanotum, the ventral apices of the four anterior femora, the dorsal margin of the four anterior tibiæ, the ventral margin of the posterior femora, an incomplete line on the dorsal margin of the posterior tibiæ, a broad band on the first and second tergites, on the second broadly narrowed laterally and slightly edentate in the middle, a narrow band on the third and fourth tergites, that on the third with a broad median truncate portion anteriorly, and lateral apical spots on the second and third sternites yellow; calcaria and spines, pallid; insect densely clothed with long white hair; wings hyaline, slightly milky; venation dark brown with a pale brown shadow.

Santa Ana, Peru. One male collected August 3, 1911, at an altitude of 3,000 feet.

Type.—Cat. No. 15101, U.S.N.M.

Family MUTILLIDÆ.

Genus SPHAEROPHTHALMA Blake.

SPHAEROPHTHALMA SALAVERENSIS, new species.

Female.—Length 15 mm. Mandibles edentate with a faint tooth on the inner margin; antennal foveæ deep, sharply defined above by carinæ; malar space much shorter than the eye which is round and convex; scape curved; third antennal joint subequal with the fourth and fifth; posterior margin of the head without a carina; head and thorax with close, large punctures; thorax not dentate laterally; anterior margin of the pronotum truncate; posterior margin of the propodeum truncate, propodeal spiracle elongate; legs normal; first abdominal segment subnodose, surface punctured like the thorax; second tergite with large, irregular, shallow punctures; second sternite sculptured like the thorax; pygidium poorly defined,

Digitized by Google

at apex surface punctato-granular; first sternite without a carina. Black; second tergite with four circular, ferruginous spots; antennæ, clypeus, vertex, metapleuræ, legs, first tergite, all the sternites, and apical tergite with long, yellowish white hair; thorax above and second tergite with long black hair; sides of the head, posterior face of the propodeum and the third to fifth tergites with a mixture of black and white hair.

The Desert of Salavery on the coast of Peru. Described from one female collected June 25, 1911.

Type.—Cat. No. 15115, U.S.N.M.

SPHAEROPHTHALMA PERUVIANUS, new species.

Female.—Length 18 mm. Mandibles edentate; antennal foveæ strongly defined by carinæ; malar space as large as the eye which is circular and strongly convex; head and thorax with large, close punctures; scape curved; flagellum with the first joint longer than the second and third; the posterior margin of the head with a sharp carina; pronotum laterally bidentate, the basal angles and the lateral angles being edentate; the basal lateral angle of the mesoscutum edentate; spiracle of the propodeum elongate, in a depression; the concavities of the pleuræ polished, impunctate; propodeum very narrow, sharply truncate posteriorly; legs of the normal type; first sternite without a carina; first tergite very short, sharply perpendiculate anteriorly, depressed before the anterior margin which is ridged, sessile with the second; the second much broader than third, subnodose; surface with short incomplete longitudinal carinæ; pygidium not defined, the apex finely granular. Black; the second tergite with two, large, circular, ferruginous spots; antennæ, clypeus, vertex, mesoscutum, two lines on the propodeum, lateral margin of the first tergite and the lateral margins of the three following tergites, meso–and metapleuræ, and the sides of the first sternite with dense yellowish hair; scattered hairs on the legs and venter yellowish.

Santa Ana, Peru. Described from one female collected at an altitude of 3,000 feet August 3, 1911.

Type.—Cat. No. 15114, U.S.N.M.

Superfamily SPHECOIDEA.

Family SPHECIDÆ

Genus CALLOSPHEX Kohl.

CALLOSPHEX ERYTHROGASTRA, new species.

Superficially this species looks very like *Palmodes rufiventris* (Cresson), but it differs from this widely in the structure of the clypeus. This species is placed in the genus *Callosphex* because it runs there in

Digitized by Google

Ashmead's generic synopsis and because no important characters are known to separate it from this genus. In Fernald's generic table, using the first character as more important one, it would run to *Palmodes* but will not agree with the description of *Palmodes* in the character of the clypeus. *Harpactopus edwardsi* Cameron which is described from this region has the tarsal claws with four teeth and the second recurrent veins interstitial with the second transverse cubitus, and there are other differences which will separate *edwardsi* from *erythrogastra*.

Female.—Length 12 mm. Inner margins of the eyes very slightly converging toward the clypeus; clypeus with apical margin depressed, truncate except a narrow, shallow median notched; clypeus finely granular except the median area which is shining with a few large, scattered punctures; supraclypeal area triangular in outline, slightly convex; head finely granular with a few scattered punctures; median impressed line incomplete; ocelli inclosed by a faint linelike furrow; the postocellar line subequal with the ocellocular line; intraocellar line about three-fourths the length of the postocellar line; antennæ filiform, third joint about one-third longer than the fourth; mesoscutum granular laterally, the disk shiny, sparsely punctured; scutellum shiny, sparsely punctured with a faint impressed, median line; propodeum finely, closely granular; a linelike furrow separating off the dorsal aspect into a U-shaped area similar to that found in the subfamily Sceliphroninæ with the exception that this area is not raised; anterior femora slightly swollen basally; tarsal comb present but not uniform; tarsi normal, rather feebly spined; claws with two inner teeth near the base; second cubital cell narrower on the cubitus; first recurrent vein nearly interstitial with the first transverse cubitus, second recurrent vein received well into the third cubital cell; petiole a little longer than the hind coxa; abdomen shiny, the apical ventral segment subcompressed. Black; abdomen from the petiole rufous; head and thorax clothed with long black hair; the inner margins of the eyes below the antennæ with sparse appressed silvery pubescence; wings bluish, dusky apically; venation dark brown.

Cuzco, Peru. Described from one female collected July 4, 1911, at an altitude of 11,500 feet.

Type.—Cat. No. 15091, U.S.N.M.

Genus AMMOBIA Billberg.

AMMOBIA SPINIGRA (Kohl).

A male of this species was collected in the Panama Canal Zone June 12, 1911.

Digitized by Google

Genus ISODONTIA Patton.

ISODONTIA BIPUNCTATA, new species.

This may be *Sphex robusta* Cameron, but judging from his description it would seem that he had a specimen which was punctured like *azteca* Fernald or *macrocephala* Fox. He says "vertex shining," in the species here described the vertex is opaque. His specimen is also said to have gray hair on the metapleurae, in *bipunctata* the hair on the metapleurae is black.

Female.—Length 20 mm. Head slightly broader than the thorax, opaque, very finely, closely punctured, the vertex with large, distinct punctures interspread; frontal impressed line strong, complete, dividing at the anterior ocellus and extending to the slightly depressed area latrad of each posterior ocellus; ocelli in a low triangle, the distance between one of the lateral ones and the anterior one subequal with the width of the anterior ocellus; supraclypeal area sharply carinate; clypeus finely granular with a number of large punctures laterally, the anterior margin depressed in the middle with two short, obtuse, broad lobes which are separated from each other by an emargination which in width is equal to about half the width of the lobe; mandibles very broad, stout, bidentate apically, the inner and outer teeth subequal in length (see fig. 1); antennae slightly thickening apically, the joints subnodose, third joint one-third longer than the fourth, the fourth slightly shorter than the fifth; mesoscutum opaque, finely, closely punctured with a number of larger punctures interspread; scutellum shiny, sparsely punctured; mesepisternum punctured like mesoscutum; dorsal aspect of the propodeum finely, transversely aciculate with many rather close, medium-sized punctures, in appearance opaque; legs rather feebly spined; petiole about twice the length of the posterior coxae; venation of the normal type. Metallic blue-green; mandibles, anterior margin of the clypeus and palpi rufous; legs, except the four posterior femora beneath which are piceous, scutellum and pronotum black; antennae black, the basal joints of the flagellum slightly piceous beneath; lower inner margins of the eyes, superior posterior orbits, tubercules, prepectus, spot above the intermediate coxa, spot above the posterior coxa, and the abdomen with short, appressed silvery pubescence; face, clypeus, pronotum, anterior part of the mesoscutum, mesepisternum, propodeum and femora with black hair; the vertex of the posterior orbits with long gray hair or a mixture of black and gray; posterior part of the mesoscutum with short gray hair; wings purplish, slightly paler apically; venation dark brown.

Panama, Canal Zone. One female collected June 17, 1911.

Type.—Cat. No. 15090, U.S.N.M.

Digitized by Google

Kohl's idea of *azteca*, judging from his descriptions and a letter to Fernald,[1] is the same as Fernald's if we add the variety *cinerea* to Fernald's description, but as neither of these descriptions describes as accurately as desired the dentation of the mandibles, and inasmuch as we have names which will agree with all the forms of the museum, it has been considered best to leave *azteca* out of the following table. Judging from the original description of *azteca* which says "*cinerea-hirtus*," the variety *cinerea* Fernald will have to be considered as the same as *azteca*, and the name *macrocephala* will be used for *azteca* Fernald. According to Fernald these two would well be considered the same, as there seems, by the study of additional material, to be a variation in the amount of black pubescence on *cinerea*. From the standpoint of the types *macrocephala*, *cinerea*, and *bipunctata* may be separated by the following table (see fig. 1):

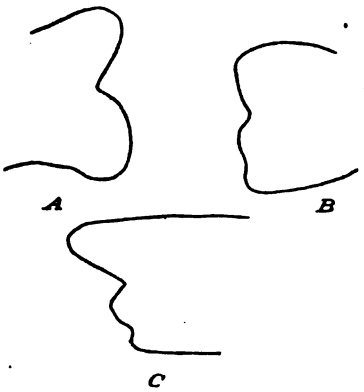


FIG. 1.—APICES OF MANDIBLES IN ISODONTIA. *A*, CINERA FERNALD (COTYPE); *B*, BIPUNCTATA ROHWER (TYPE); *C*, MACROCEPHALA FOX (TYPE).

Outer tooth of mandibles much longer than the inner; (head and thorax black, with black hair).....*macrocephala* Fox (=*aztecum* Fernald).
Outer and inner teeth of mandibles of equal length..... 1.
1. Head and thorax unipunctate, black, clothed with whitish hair, *cinerea* Fernald (=*aztecum* var. *cinerum* Fernald).
Head and thorax bipunctate, metallic, clothed with black hair, *bipunctata* Rohwer.

Genus SPHEX Linnaeus.

SPHEX (SPHEX) PERUVIANUS, new species.

Apparently most closely allied to *Sphex* [*Ammophila*] *volcanica* (Cameron), but lacks the pubescence and has the third antennal joint not more than twice the length of the fourth and the propodeum is obliquely striate.

Female.—Length 18 mm. Head broader than the thorax, opaque, finely granular with a few widely separated, incompletely defined punctures; frontal impressed line strong but not complete; ocelli in a low triangle; intraocellar line about two-thirds the length of the postocellar line; postocellar line shorter than either the ocellocular or the ocelloccipital line; anterior margin of the clypeus truncate, surface punctured like the head; supraclypeal area broad, flat; antennæ rather stout, filiform, third antennal joint subequal in length with the fourth and fifth; pronotum sculptured like the head;

[1] See Proc. U. S. Nat. Mus., vol. 31, 1906, p. 356.

Digitized by Google

mesoscutum finely, transversely or obliquely aciculate with a number of large, incompletely defined punctures; the median impressed line of the mesoscutum is strong and complete; just inside of each tegula is a broad depressed furrow which ends anteriorly in a sharp, short carina; scutellum longitudinally striato-punctate, the striæ predominating; mesepisternum coarsely striato-reticulate; metanotum sculptured like the scutellum; disk on the posterior aspect of the propodeum obliquely striato-reticulate, area bounding this obliquely striate; sides and posterior face of the propodeum striato-reticulate, propodeal spiracle about the middle of the segment; anterior tarsi without a well-defined comb, intermediate and posterior tarsi feebly spined; the post-basitarsis subequal in length with the two following joints; tarsal claws with the usual basal bristle; radial cell obtusely truncate apically; the third cubital cell on the radius much shorter than the second, the second cubital cell narrowed above by the converging of the second and first transverse cubiti; abdomen of the normal type. Black; tegulæ, abdomen, except the base of the first segment rufous; head, thorax, and legs clothed with sparse white hair; wings hyaline, faintly yellowish; venation pale brown.

Cuzco, Peru. Described from one female collected July 6, 1911, at an altitude of 11,500 feet.

Type.—Cat. No. 15099, U.S.N.M.

Digitized by Google

NOTES ON RANZANIA MAKUA JENKINS AND OTHER SPECIES OF FISHES OF RARE OCCURRENCE ON THE CALIFORNIA COAST.

JOHN OTTERBEIN SNYDER,
Of Stanford University, California.

This paper contains some observations that have been made from time to time on certain fishes which are rarely seen on the California coast. The first part is a record of the appearance in this region of *Ranzania makua* Jenkins, while the second part deals with species living in Monterey Bay.

The type of *Ranzania makua* and specimens of the other species are in the National Museum.

PART 1.

RANZANIA MAKUA Jenkins.

Plate 63.

The appearance in the eastern Pacific of an example of *Ranzania makua* is of considerable interest, since the species has been recorded only from Hawaii and Japan. The Hawaiian record is based on two specimens, the type[1] and a smaller example,[2] and also on a painting by a local artist.[3] The Japanese record rests entirely on an old painting in the collection of Count Date.[4]

The California specimen was found dead on the beach at Oceano, San Luis Obispo County, in August, 1909, by Mr. John P. Latronel. It was rather well preserved, although it had been washed about in the breakers until the silver color was almost completely removed from the body. It measures 460 millimeters in length. The upper surface of the body is dark, the edges of the hexagonal scales being very light in comparison. The sides show traces of silver here and there, but not even a suggestion of dark bands or reticulations appears. When compared directly with the type of the species

[1] Oliver P. Jenkins, Description of a new species of Ranzania from the Hawaiian Islands, Proc. Cal. Acad. Sci., ser. 2, vol. 5, 1895, pp. 780 to 784, colored plate.

[2] Jordan and Evermann, Fishes Hawaiian Islands, Bull. U. S. Fish Commission, No. 23, pt. 1, p. 440.

[3] Jenkins, Proc. Cal. Acad. Sci., ser. 2, vol. 5, 1895, p. 783.

[4] Jordan and Snyder, A review of the Gymnodont fishes of Japan; Proc. U. S. Nat. Mus., vol. 24, p. 262.

Digitized by Google

the California example is seen to be somewhat more slender, the caudal peduncle is narrower, the head and snout are shorter, the eye smaller, the fins shorter, and the color different, lacking entirely the peculiar curved bands so conspicuous on the body of the type specimen.

The measurable differences are shown in the appended table.

	California specimen.	Hawaiian specimens.	
Length of body in millimeters	430	470	101
Length head, in hundredths of length	.34	.37	.35
Depth body	.475	.515	.32
Depth caudal peduncle	.305	.39	.15
Length snout	.127	.14	.13
Diameter eye	.059	.067	.065
Interorbital width	.09	.08	.09
Distance between eye and top of head	.046	.04	.045
Between gill-opening and back	.13	.123	.115
Between gill-opening and ventral surface	.27	.32	.18
Between gill-opening and eye	.16	.165	.15
Height dorsal	.31	.35	.215
Height anal	.28	.29	.20
Length pectoral	.21	.245	.15
Length caudal	.065	.075	.08
Dorsal rays	17	17	17
Anal rays	18	18	18
Pectoral rays	13	13	13
Fully developed caudal rays	18	18	18

The second Hawaiian example was obtained in the Honolulu market by Doctor Jordan, and is now in the collection of the Bureau of Fisheries. (Pl. 63, fig. 2.) It is a young individual, measuring about 108 millimeters in length, and consequently of especial value, as it aids in illustrating some of the structural changes that occur with advancing age. It is much more elongate than the older specimens, the narrowness of the body being most evident in the caudal region. The base of the caudal fin is a straight oblique line; not convex as in older examples. The caudal rays are not fan-shaped,[1] but are branched in the ordinary way, the division appearing farther from the base than is usual among fishes. The length of the caudal fin is relatively greater, while that of the other fins is less. The body is everywhere silvery, very dark on the back. On the body behind the pectoral are about 15 more or less distinct dark spots, which are nearly equal in size to the eye. There are no bands on the head.

The Japanese figure[2] is a splendid painting, and although it omits certain slight details of structure, there can be no doubt as to the species which it represents. It delineates a form similar to that of the others, but of a different color. The plates are broadly outlined in white, except in certain restricted areas where they are narrowly bordered by brown, the centers being everywhere dark.

[1] Jenkins, Proc. Cal. Acad. Sci., ser. 2, vol. 5, 1895, p. 780, fig. 3.

[2] Through the courtesy of Count Date, who presented Doctor Jordan with a copy of the painting, a photograph is here reproduced. (Pl. 63, fig. 1.)

Digitized by Google

Silvery pigment covers the dorsal surface, and appears irregularly on the sides, cheeks, and on the caudal region between the vertical fins. There is a mass of brown color on the body below the pectoral, on the snout, and also in the region between eye and gill opening. The latter region is bordered above by a broad pink stripe with dusky borders, and there is a spot of the same color on the snout. The vertical fins are blackish; the rays of pectoral and caudal white. Unmistakable traces of curved vertical bands similar to those of the type appear on the head.

In the opinion of the writer the differences exhibited by the specimens before him and by the Japanese drawing are of such a nature that they may be attributed largely to individual variation and age, and they should not, at the present time at least, be regarded as characters distinguishing different species. Some of the apparent differences in color are clearly due to accident, as in the California example, where the thin epidermis has been almost entirely scrubbed off by the sand and the breakers, a gentle touch with a blunt instrument being sufficient to remove the silvery pigment or the dark color from the plates. It is not probable that the Japanese painting was made from a living individual; the Hawaiian specimen had been kept on ice for a long time before it was described, and consequently we only know stages of the fading color unless it is not so evanescent after death as in most other fishes.

This species is closely related to *Ranzania truncata* of the Atlantic, and a careful survey of the data at hand compels one to hesitate in distinguishing between them. For when the variation in color and form exhibited by the Pacific specimens is considered along with the information to be derived from the rather brief descriptions [1] and poor figures of Atlantic examples, one must admit that there is little or no ground for the recognition of two species except the presumption that they inhabit different and widely separated geographic regions.[2] *Mola mola*, another species of the same family, which inhabits both the Atlantic and Pacific Oceans, has been described under 30 or more specific names and placed in upward of a dozen nominal genera.

[1] Albert Gunther; Catalogue Fishes British Museum, vol. 8, p. 319. Francis Day; Fishes Great Britain and Ireland, p. 276, pl. 149. Jonathan Couch; Annals Natural History, vol. 6, p. 144; and other accounts referred to in the above volumes.

[2] Too late for incorporation in the above, the writer has seen a paper by Dr. Jacques Pellegrin on a specimen of *Ranzania truncata* from Martinique (Pellegrin, Doctor Jacques; Sur le Presence d'un Banc de *Ranzania truncata* Retzius a la Martinique; Bulletin de la Société Zoologique de France, tome 37, 1912, p. 228). An examination of the description and the figure there given leaves no doubt as to the identity of *R. truncata* and *R. makua*. In this connection Doctor Pellegrin says: "La coloration de ces individus se rapproche tout à fait de celle donnée par Jenkins, pour une espèce des îles Hawaï, qu'il décrit comme nouvelle sous le nom de *Ranzania makua*. En l'absence du type et ne pouvant contrôler les autres caractères, il est difficile de se prononcer d'une façon catégorique, mais cette ressemblance de coloration incite à penser que l'espece des îles Hawaï n'est probablement pas distincte de celle de la Martinique."

Digitized by Google

PART 2.

SPECIES FROM MONTEREY BAY.

It is largely through the kindly interest of Dr. Harold Heath, Messrs. Walter Weymouth, and William F. Allen that the writer has been enabled to obtain specimens of the species here noted. Most of them were taken while dredging in the shallow water near shore in Monterey Bay.

Family BRANCHIOSTOMIDÆ.

BRANCHIOSTOMA CALIFORNIENSE Gill.

Three specimens of this species were dredged from the sandy bottom opposite Monterey at a depth of about 5 fathoms. They measure 65 to 76 millimeters. The myocommata number as follows:

45–16–10:71
44–17– 9:70
44–16– 9:69

Family ICOSTEIDÆ.

ICOSTEUS ÆNIGMATICUS Lockington.

A young example of this form was found on the beach near Pacific Grove. It measures about 80 millimeters. Spicules are present along the lateral line and on the rays of the dorsal, anal, and caudal fins. The color differs from that of the adult, there being 7 dark vertical bands on the body. These are confined to the region extending between the interneurals and interhæmals, which are plainly visible in the translucent body. Before the anterior band and just behind the occiput is a round spot. The posterior band is at the base of the caudal fin. The bands are somewhat narrower than the light interspaces. The third band, counting from the caudal, unites above and below with large, dark spots. Similar spots are above and below the fifth band from the caudal, and there is an elongate spot at the base of the anterior third of the dorsal fin. The bands and spots on the opposite (left) side of the body differ somewhat in their relations to each other. The caudal and anal are broadly edged with blackish; the pectoral narrowly bordered with black; ventrals black. When fresh, the head and body were translucent, with a light straw tint. There are 53 rays in the dorsal fin, 38 in the anal.

Family COTTIDÆ.

ICELINUS QUADRISERIATUS (Lockington).

A specimen having the ventrals deep black was taken at a depth of 10 or 12 fathoms near Pacific Grove.

Digitized by Google

Family AGONIDÆ.

ODONTOPYXIS TRISPINOSUS Lockington.

Eight examples from a depth of 5 to 10 fathoms near Pacific Grove.

STELLERINA XYOSTERNA (Jordan and Gilbert).

One specimen from about 10 fathoms near Monterey.

AVERRUNCUS EMMELANE Jordan and Starks.

Three individuals measuring 53 to 65 millimeters, from 10 to 15 fathoms near Pacific Grove.

Family PLEURONECTIDÆ.

PLEURONICHTHYS DECURRENS Jordan and Gilbert.

The young of this species (measuring 35 to 60 millimeters), of which a considerable number were secured at depths of 10 or 15 fathoms, exhibit a brilliant type of coloration not seen in the adult. The body is variously spotted and clouded with black and brownish black, reticulations and ocelli also appearing without any particular order. A black spot or ocellus is usually present on the lateral line near middle of body. The dorsal has about 12, the anal usually 11 vertical black bars or elongate spots, most of which involve two or three rays and extend from base to near tip of fins; some broken in the middle or only represented by a comparatively small distal spot. Both dorsal and anal are bordered with white. The caudal is dusky, with white edges and a white bar across the base. The dusky central portion is often broken by white lines parallel with the rays. The blind side is often finely speckled.

Family GOBIIDÆ.

RHINOGOBIUS NICHOLSI (Bean).

Examples from depths of 10 or 15 fathoms near Pacific Grove were pale blue gray in life, tinted with light yellow on the head; chin and throat yellow; sides with five indistinctly defined, dusky vertical bars; scales with narrow orange borders; dorsals and caudal yellow, the rays and spines dotted with bright orange; spinous dorsal broadly edged with deep black; anal suffused with yellow; pectorals light; ventrals black. Some specimens were less brightly colored, the ventrals being almost immaculate.

Family BATHYMASTERIDÆ.

RATHBUNELLA ALLENI Gilbert.

An example measuring 125 millimeters was taken in a pool near the water's edge at very low tide. The dorsal fin has an elongate, black-

Digitized by Google

ish spot on the upper anterior edge. The head is contained 4.5 times in the length to base of caudal. Dorsal 44; anal 33; pectoral 17.

Family BLENNIIDÆ.

NEOCLINUS BLANCHARDI Girard.

The young of this species, measuring about 44 millimeters, have 12 or 13 conspicuous crossbands on the body and a row of 11 spots just below the base of dorsal fin, some of the spots coinciding in position with the bands. The anterior ocular cirrus is but little longer than the posterior ones. The maxillary reaches beyond the eye but is not quite equal in length to half the head. Found in the pools near Pacific Grove.

NEOCLINUS SATIRICUS Girard.

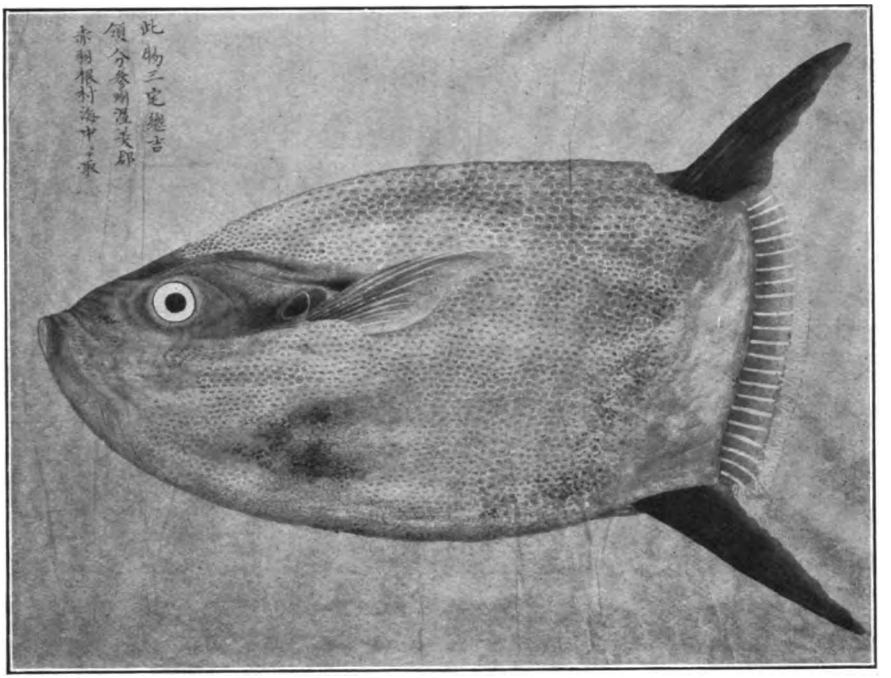
A specimen 100 millimeters in length, from a pool near Pacific Grove, has the maxillary very short, not quite reaching the edge of the preopercle. The filaments of the head are short. An ocellus is present between the sixth and ninth spines.

Family OPHIDIIDÆ.

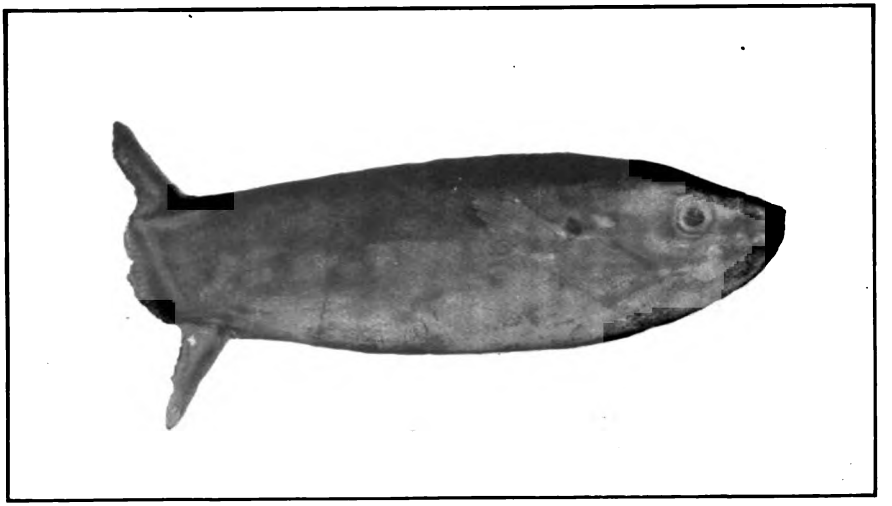
CHILARA TAYLORI Girard.

In young individuals the body, excepting the abdomen, is covered with minute brown specks, the spots characteristic of larger examples being absent. Taken at depths of 10 or 12 fathoms near Pacific Grove.

Digitized by Google



1.



2.

RANZANIA MAKUA JENKINS.

FOR DESCRIPTION OF SPECIMENS SEE PAGE 455.

Digitized by Google

Digitized by Google

TWO NEW SPECIES OF DIPTERA IN THE UNITED STATES NATIONAL MUSEUM COLLECTION.

By J. R. MALLOCH,

Of the Bureau of Entomology, United States Department of Agriculture.

One of the species described in this paper was collected by Mr. R. P. Currie in 1903, and has remained among the undetermined Anthomyidæ since. The other is a recent addition to the collections of the United States National Museum, which it is considered advisable to describe in addition to those species belonging to the Borboridæ, which have already been included in a previous paper.

FANNIA TIBIALIS, new species.

Male.—Eyes rather widely separated for a male of this genus, the narrow central stripe opaque black, narrower than the orbits at below ocelli, orbits shining, silvery white, which color is carried increasingly broader to opposite base of antennæ and from this point to lower angle of eyes at a gradually diminishing breadth, frons slightly buccate, mouth margin and cheeks slightly projecting, antennæ black, third joint brown pollinose, arista black, shining and slightly swollen at base, palpi black; mesonotum opaque gray-brown with three dark brown stripes interrupted anteriorly and posteriorly, as well as a spot behind humeri and one above wing bases of same color, acrostical bristles in three rows, the center row the weakest and rather irregular, scutellar bristles very long, the usual four much the longest, pleuræ darker than disk of mesonotum; abdomen narrow, elongate-oval, gray, dorso-central stripe brown, narrow, distinct and parallel-sided, not triangularly dilated on segments, all segments with numerous, moderately long bristles, hypopygium small, gray-brown; legs black, tibiæ and apices of femora yellow, anterior femora with a row of long bristles on each of the postero-dorsal, posterior, and postero-ventral surfaces, mid femora not noticeably constricted at apex, antero-ventral surface with seven almost equally long bristles on basal half, the basal one being weak and hairlike, and 13–14 on apical half, which steadily decrease in length and become closer as they near apex, postero-

Digitized by Google

ventral row longer, more regular, and not decreasing very much at apex, the basal two bristles in this row are hairlike, posterior surface with a row of fine hairlike bristles, the last four at apex very stout and strong, the row on the anterior surface is much stronger, but ends in 3–4 curled bristles, which are rather weaker than the apical four in posterior row, mid tibiæ only gradually thickened, and not much so from base to apex, the pubescence loose but short, and not much longer at apex than at base, bristling normal, the usual two bristles at same distance from apex, hind femora with an irregular row of moderately long but weak bristles on basal four-sevenths, and three much longer and stronger beyond them, as well as 6–7 very short but strong bristles on apical seventh on antero-ventral surface, postero-ventral row much longer, more hairlike and more regular, anterior surface with a row of short bristles which are of almost equal length to middle, then become longer and stronger, and run up to and over dorsal surface at in front of tip, below the last two bristles—on antero-dorsal surface—are two additional bristles, hind tibiæ with the usual two dorsal, two antero-dorsal—one at almost in transverse line with upper dorsal and one smaller at near apex—and two antero-ventral bristles, the upper and smaller being in transverse line with upper dorsal and the stronger at a little nearer the apex; wings yellowish, veins brown, paler at base, inner cross vein backwardly directed, outer cross vein bent, as long as penultimate section of fourth and joining that vein at two-fifths from inner cross vein to wing margin; calyptræ with lower scale slightly the larger; halteres bright yellow.

Length, 5½ mm.

Two males, Kaslo, British Columbia, June 9 and 15, 1903 (R. P. Currie).

Type.—Cat. No. 15216, U.S.N.M.

Allied to *fuscula* Fallen, but separable by the absence of the coxal thorns.

LIMOSINA TROCHANTERATUS, new species.

Male.—Black, shining; frons at center about one-third broader than long; black, subopaque, except on stripes occupied by central rows of bristles and at bases of orbital bristles, where it is shining, orbital bristles strong, the lower one slightly the weakest; in addition to the usual bristles there are only 2–3 weaker bristles present on the orbits, two of which are situated anterior to the lower orbital bristle, and one between it and the second, but nearer to the center of frons; center rows each of four bristles, the lower two in each row the strongest, anterior margin of frons transverse, below and slightly above base of antennæ there is a distinct production which is carried down to epistome and forms a keel to the face, face opaque brown-black, in profile concave in center, anterior vibrissa very strong,

Digitized by Google

incurved, second much weaker, those on jowl numerous and slightly upcurved, jowl at center not half as high as eye at center, antennæ black, basal joint with several rather long bristles, third joint with thick, short, pale pilosity, arista subbasal, distinctly pubescent, one and one-half times as long as breadth of frons, palpi black; mesonotum shining, indistinctly three-striped, posthumeral bristles strong, incurved, four pairs of dorso-central bristles, acrostical bristles stronger than usual and distinguishable from the usual dorsal setulæ, scutellum subopaque, longer than broad, rounded, with eight marginal bristles, the anterior pair much the weakest, being only half as large as third pair, which are but half as large as second and posterior pairs; abdomen subopaque, second segment as long as segments 3–5 together, the other segments subequal, there are numerous bristles on lateral margins of second and several long and numerous short bristles on lateral and posterior margins of fourth and fifth segments, hypopygium glossy black, with a large central apical depression and numerous surface hairs, ventral surface of hypopygium and abdomen at apex hairy; legs black, only the apices of mid coxæ and trochanters yellowish, fore tibiæ with pale pilosity on apical half of ventral surface, mid trochanters with a long, strong, curved bristle directed toward apex of femur, mid femur with a row of regular, short, but strong bristles on apical half of anterior surface, the one at apex much the strongest, posteriorly with one at apex, mid tibiæ with about 10 bristles on dorsal surfaces—five on basal third, the basal one single, the next four paired and much stronger, and five in a group at beyond middle—one ventral bristle beyond middle and 2–3 apical spurs, all mid tarsal joints except apical one with apical spines, those on metatarsus very strong, hind femur normal, hind tibiæ with rather irregular dorsal setulæ, one of which at apical third is distinctly stronger than the others, hind metatarsus not much dilated and about half as long as second joint; wings clear, costa spinose to end of first vein, from humeral vein to end of first vein two-thirds as long as third costal division, second division two and one-half times as long as third, costa ending at apex of third vein, basal portion of third vein subequal to second portion of fourth, last portion with a distinct upward bend and ending distinctly in front of wing tip, outer cross vein about one and one-half times as long as inner and half as long as second portion of fourth, fourth vein indistinctly traceable to near wing margin, but neither it nor the fifth carried distinctly beyond cross vein; halteres with yellow knob and fuscous stalk.

Length, 2½ mm.

One female, Rosslyn, Virginia, August 25, 1912 (J. R. Malloch).

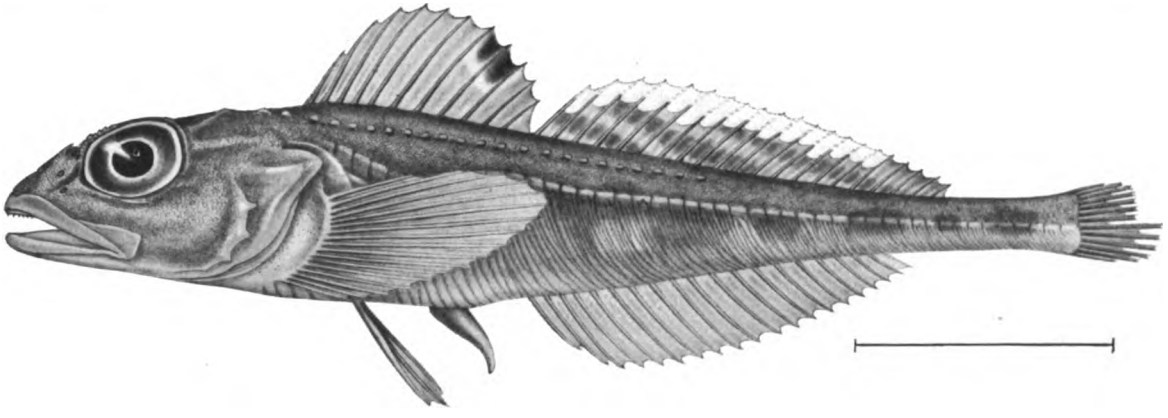
Type.—Cat. No. 15217, U.S.N.M.

Distinguishable from any described American species by the thornlike bristle on the mid trochanters.

Digitized by Google

Digitized by Google

Digitized by Google



TRIGLOPS OMMATISTIUS. TYPE.

FOR DESCRIPTION SEE PAGE 465.

Digitized by Google

DESCRIPTIONS OF TWO NEW FISHES OF THE GENUS TRIGLOPS FROM THE ATLANTIC COAST OF NORTH AMERICA.

By CHARLES H. GILBERT,

Professor of Zoology, Stanford University.

The cottoid genus *Triglops* has been assumed to be represented in the North Atlantic by a single species, *Triglops pingeli*, supposed to be common to the European and American coasts, if, indeed, not circumpolar in its distribution. This fixed idea has been responsible, doubtless, for the long neglect of American material, although such notes concerning it as have been published have indicated a form with fewer fin rays than any known species and, furthermore, with a distinctive black ocellated spot on the spinous dorsal fin, wholly unknown elsewhere.

Through the kindness of the authorities of the United States National Museum the writer has had the privilege of examining all their American material from the Atlantic coast, and describes therefrom the following new species from the coast of New England and a new subspecies from the region of Newfoundland:

TRIGLOPS OMMATISTIUS, new species.

Plate 64.

Triglops pingeli GOODE and BEAN, Bull. Essex Inst., vol. 11, 1897, p. 13.—JORDAN and GILBERT, Fish. North Amer., 1882, p. 713.—GOODE and BEAN, Oceanic Ichth., 1895, p. 267, fig. 256. Not of Reinhardt.

Type.—Cat. No. 73921, U.S.N.M., a male, 105 mm. long to base of caudal, the caudal fin injured, the total length approximately 120 mm; from Gloucester, Massachusetts.

Measurements in hundredths of total length without caudal: Length of head 30; length of snout 9; diameter of orbit 8.2; interorbital width 3; length of maxillary 13; greatest depth of body 18; least depth of caudal peduncle 4.2.

Dorsal XI, 21; anal 20; pectoral 17; ventral I, 3. Plates along lateral line 45.

Digitized by Google

Snout sharp, mouth horizontal, the tip of the maxillary reaching to below the middle of the rather large eye, which almost equals the length of the snout. Interorbital space narrow, gently concave, its width but little more than half the diameter of the pupil. Teeth rather coarse, in broad bands in jaws and on vomer, the palatines toothless. Preopercle with four small spines, the upper directed obliquely upward and backward, the second horizontally backward, the third and fourth forward and downward. Occiput flat, or very gently concave, a pair of low diverging ridges at its posterior margin, and a pair of small tubercles (very short converging ridges) immediately behind orbits. Gill membranes widely joined, free from the isthmus, their posterior margins deeply incurved.

Fins all injured. Last dorsal spine joined by membrane to base of first ray of second dorsal. Both ventrals and pectorals extend beyond origin of anal fin. Vent midway between base of ventrals and front of anal fin. Anal papilla reaching base of first anal ray.

Shagreen very fine, covering entire back and sides of head with exception of the mouth parts. The small spinous scutes of the dorsal series diminish in size posteriorly and disappear at some point under the last half of the dorsal fin.

Lateral line with a strong downward curve near its origin, rising again opposite the vent, parallel thence with the curve of the back. The scutes are very finely and evenly spinous on the free margins, without longer spines at the posterior angle. The lateral folds are very numerous, the primary folds descending from the posterior margins of the plates of the lateral line, a number of secondary folds intercalated between them, usually only one or two of each set of secondary folds extending to the lower margin of the spinous area. These spinous plates cover also the anterior part of the trunk behind the axils, and a few from opposite sides commonly meet on median line in front of origin of anal fin. In the type, 45 folds reach to just above the base of the anal fin. Breast with a number of cross folds, varying in number, but usually 5 or 6. The folds do not approach the median line between the ventrals and the vent.

The back is marked with four dark crossbars which reach the lateral line, one under spinous dorsal, two under soft dorsal, and one on caudal peduncle. Below the lateral line is a series of short blackish quadrate spots or blotches, separated by silvery interspaces (or it may be interpreted as a lengthwise silvery streak interrupted by dark blotches). The breast and belly, the postaxial region, and the area in front of all but upper pectoral rays bright silvery. In males, a roundish black spot on distal half of posterior dorsal spines, broadly margined with silvery white, except at the free edge of the fin. A similar but much smaller spot on anterior dorsal spines. There is no trace of these spots in females, and they are not present in very

Digitized by Google

young males. Soft dorsal in males with wide oblique or nearly horizontal bars, in females with narrow dotted lines. Other fins unmarked.

In 10 cotypes from the Gulf of Maine (Cat. No. 45547, U.S.N.M.), from Cape Cod (Cat. No. 43067), from George's Bank, and from Gloucester, Massachusetts, the fin rays are as follows:

	Dorsal spines.		Dorsal rays.		Anal rays.		Pectoral rays.	
Number	X	XI	21	22	20	21	17	18
Specimens	5	5	2	8	2	8	9	1

Among the collections of the United States National Museum are numerous specimens taken by the Fisheries steamer *Albatross* off the coast of Newfoundland and Nova Scotia, which agree with typical *ommatistius* from the New England coast in all respects save the armature of the body. In the northern specimens, without exception, the primary folds only are developed, and agree in number, therefore, with the scutes of the lateral line with which they are connected, while in typical *ommatistius* many secondary folds are intercalated. In the northern specimens again the breast is naked, or contains few partial cross folds, the postpectoral area is widely naked in its lower portion, and the lower part of caudal peduncle is also frequently naked or nearly so. The lateral folds do not meet across the median line in front of the anal fin.

In all other respects of shape, fin rays, and color, including the ocellate spots on dorsal in the males, the two forms agree, but they can be distinguished at a glance, and being geographically separate are worthy of recognition. The northern form would seem worthy of specific rank were it not that two specimens of the collection, one from off Chebucto Head, Nova Scotia, and one from Georges Bank, Massachusetts, seem to a certain extent intermediate. Also, among perfectly typical examples of *ommatistius* from Gloucester, is a single young specimen typical of the north. For these reasons, with the probability of further intergradation being found, I propose to recognize the northern form as a subspecies.

TRIGLOPS OMMATISTIUS TERRÆNOVÆ, new subspecies.

Type.—Cat. No. 46063, U.S.N.M., a male specimen 95 mm. long to base of caudal, 110 mm. in total length, from Fisheries steamer *Albatross* Station 2445, off Newfoundland (lat. 45° 09′ 30″ N; long. 49° 48′ 30″ W.); depth, 39 fathoms.

Dorsal XI, 21; anal 21; pectoral 18; ventrals I, 3. Scutes in lateral line 47, diminishing greatly in size on caudal peduncle, one or two of the posterior ones lacking. No intercalated secondary folds, the number of those terminating immediately above base of anal fin

Digitized by Google

26 (45 in type of *ommatistius ommatistius*). Breast with short traces only of two cross folds; in many cotypes the breast is wholly naked, in others with three or four folds. Sides of abdomen largely naked. No folds approach median line in front of anal fin.

Fifty-seven cotypes of *T. ommatistius terræ-novæ* have been examined from *Albatross* collections off the coasts of Newfoundland (stations 2438, 2441, 2444, 2445, 2446, 2449, 2450, 2451, 2466, 2492, 2493), all holding perfectly the distinctive characters of the subspecies. They vary principally in the plating of the caudal peduncle, the sides of the abdomen, and the breast, some specimens being much more completely naked than others. In 25 specimens the fin rays range as follows:

	Dorsal spines.		Dorsal rays.			Anal rays.			Pectoral rays.		
Number	X	XI	21	22	23	20	21	22	17	18	19
Specimens	17	8	3	16	6	3	13	9	10	14	1

Unfortunately no specimens of *Triglops* are available from the west coast of Greenland. Four individuals taken by the Zoological Polar Expedition of 1900, off the east coast of Greenland (lat. 72° 25′ N.), indicate a species totally distinct from the forms here described. Two are males and two females, and all agree in the characteristic lengthwise brown streaks and spots below the lateral line, the blunt snout, and the very large eye, as figured by Collett from Norwegian material.[1] None of them resembles the female he there figures (fig. 10), either in the smaller eye, the sharper snout, the coloration, or in the lesser number of rays in the pectoral fin (18). The fin counts in our four Greenland specimens follow:

	Dorsal fins.	Dorsal rays.		Anal rays.		Pectoral rays.	
Number	XI	25	26	24	25	21	22
Specimens	4	2	2	2	2	2	2

[1] Norw. N. Atl. Exp., pl. 1, fig. 9.

Digitized by Google

RESULTS OF THE YALE PERUVIAN EXPEDITION OF 1911. HYMENOPTERA—ICHNEUMONOIDEA.

By H. L. Viereck,

Of the Bureau of Entomology, United States Department of Agriculture.

Of the three species of Ichneumonidæ collected by the Yale Peruvian Expedition, all of which proved to be new to science, one belongs to *Cylloceria* Schiödte, a genus new to South America; another to *Trachysphyrus* Haliday, a little-known South American genus; while the third species belongs to *Anisitsia* Viereck, recently described from North America, but well represented in both North and South America. No other species of this superfamily were submitted for determination.

ANISITSIA TINCOCHACÆ, new species.

Type-locality.—Tincochaca, 7,000 feet, Peru.

Type.—Cat. No. 15116, U.S.N.M.

Female.—Length, 11.5 mm.; head, including antennæ, palpi, mandibles, and labrum, shining black or at least blackish, lateral ocelli nearer to the eyes than to each other, but nearer to each other than to the occipital carina; thorax finely, opaquely sculptured and punctured, including the stigma, veins, wing base, tegulæ, coxæ, and trochanters black or blackish, rest of legs mostly blackish red, wings faintly tinged with black; propodeum black and opaquely sculptured, mostly reticulated, with the basal and apical transverse carinæ more or less developed, as in some cryptini, the apical transverse carina produced into a blunt process on each side, petiole black, postpetiole and rest of abdomen rather castaneous, exserted portion of the ovipositor hardly as long as the apical truncature of the abdomen.

Labeled, "Collected August 10, 1911."

CYLLOCERIA TINCOCHACÆ, new species.

Type-locality.—Tincochaca, 7,000 feet, Peru.

Type.—Cat. No. 15117, U.S.N.M.

Male.—Length, 8 mm.; related to *C. marginator* Schiödte, from which it differs chiefly in the straight, more distinctly marginated,

Digitized by Google

posteriorly converging sides of the scutel, in the median longitudinal carinæ of the propodeum converging posteriorly, and in the presence of two longitudinal carinæ on the first dorsal abdominal segment between the spiracles and the base of the segment.

Labeled, "Collected August 8, 1911."

Genus TRACHYSPHYRUS Halliday.

As determined by the writer, this genus goes to *Callicryptus* Ashmead, as placed in Schmiedetnecht's table in Genera Insectorum. The latter genus is, however, misplaced and belongs properly near *Melanocryptus* Cameron in the same table. The notauli in *Trachysphyrus*, as represented by the following species, extend as distinct furrows to beyond the middle of the dorsulum.

TRACHYSPHYRUS CLEONIS, new species.

Type-locality.—Cuzco, 11,500 feet, Peru.

Type.—Cat. No. 15118, U.S.N.M.

Female.—Length, 12 mm.; head shining, as seen from in front virtually as long as wide, face greenish with purplish reflections, clypeus purplish, with a few punctures, cheeks purplish, with widely separated punctures, mandibles black, with purplish and greenish reflections, front and vertex greenish, with purplish reflections, lateral ocelli virtually as near to the eyes as to each other, scape apparently shorter than the first joint of the flagel, the latter a little longer than the next joint, scape greenish and purplish, pedicel and flagel blackish, with reddish-brown sutures, palpi blackish; thorax shiny and mostly greenish, dorsulum highly polished and punctured, purplish, pronotum striated, mesopleuræ wrinkled, tegulæ with scattered punctures and purplish, wings dark blackish-brown, with violaceous reflections, stigma and veins blackish, coxæ and trochanters mostly purplish, femora and tibiæ reddish, tarsi mostly blackish; propodeum greenish, wrinkled, and shining; abdomen finely shagreened and purplish, exserted portion of the ovipositor apparently two-thirds as long as the abdomen.

Labeled, "Collected July 9, 1911."

Digitized by Google

A SYNOPSIS OF THE AMERICAN MINKS.

By N. HOLLISTER,
Assistant Curator, Division of Mammals, United States National Museum.

No complete review of the American forms of the subgenus *Lutreola* has appeared since Mr. Outram Bangs, in 1896, published his Notes on the Synonymy of the North American Mink.[1] In this paper, the first to deal with the subject from the modern point of view, with the geographical races treated as subspecies, Mr. Bangs recognized four forms, the *vison*, *lutreocephala*, and *vulgivaga* of the present revision, and a new subspecies, *energumenos*, from the Pacific coast. This latter form included, in addition to the restricted *energumenos* of later workers, the minks afterwards described as *ingens*, *melampeplus*, and *nesolestes*.

Since the publication of Mr. Bangs's paper the number of described forms of American minks has grown to ten, including one species known only from the bones and teeth, and probably extinct.

A careful review of the minks in the collection of the United States National Museum has shown that while all the described forms must be recognized, the lack of revisionary work with a large collection has kept the group in an unsatisfactory condition, and that the ranges and characters of the various subspecies were imperfectly known. In all the more comprehensive works of reference the ranges are incorrectly given, and in many regional lists the specimens have been wrongly identified. It has seemed important, therefore, that the results of the examination of this material, some 370 specimens in all,[2] should be published.

Genus MUSTELA Linnæus.

1758. *Mustela* LINNÆUS, Syst. Nat., ed. 10, vol. 1, p. 45. *Type.*—*Mustela erminea* Linnæus.

Subgenus LUTREOLA Wagner.

1841. *Lutreola* WAGNER, Suppl. Schreber's Säugthiere, vol. 2, p. 239. *Type.*—*Mustela lutreola* Linnæus.

[1] Proc. Boston Soc. Nat. Hist., vol. 27, pp. 1–6, March, 1896.

[2] In addition to the material in the United States National Museum collection proper, a few especially instructive specimens from the Biological Survey, Department of Agriculture, have been studied.

Digitized by Google

LIST OF AMERICAN FORMS WITH TYPE LOCALITIES.

Mustela vison vison Schreber.....Eastern Canada.
lutreocephala Harlan.....Maryland.
lutensis (Bangs).....Matanzas Inlet, Florida.
vulgivaga (Bangs).....Burbridge, Louisiana.
letifera nobis.....Elk River, Minnesota.
lacustris (Preble).....Echimamish River, Keewatin.
energumenos (Bangs).....Sumas, British Columbia.
nesolestes (Heller).....Admiralty Island, Alaska.
melampeplus (Elliot).....Kenai Peninsula, Alaska.
ingens (Osgood).....Fort Yukon, Alaska.
macrodon (Prentiss).....Brooklin, Maine.

MUSTELA VISON VISON Schreber.

1777. *Mustela vison* SCHREBER, Die Säugthiere, pl. 127*b*.
1800. *Lutra vison* SHAW, Gen. Zoöl., vol. 1, p. 448.
1800. [*Mustela*] *minx* TURTON, Syst. Nat., vol. 1, p. 58. (North America.)
1829. *Mustela* (*Putorius*) *vison* RICHARDSON, Faun. Bor.-Amer., vol. 1, p. 48.
1830. [*Putorius*] *vison* GAPPER, Zool. Journ., vol. 5, p. 202.
1854. *Putorius nigrescens* AUDUBON AND BACHMAN, Viv. Quad. North Amer., vol. 3, p. 104. (Mountains of Pennsylvania, northern New York, Vermont, and Canada.)
1857. *Mustela winingus* BAIRD, Mamm. North Amer., p. 177 (in synonymy).
1877. *Putorius* (*Lutreola*) *vison* COUES, Fur Bear. Anim., p. 160.
1899. *Putorius vison vison* MILLER, Bull. N. Y. State Mus., vol. 6, No. 29, p. 350 (October), November 18.
1899. *L*[*utreola*] *vison* JORDAN, Man. Vert. North. U. S., ed. 8, p. 344.
1902. *Lutreola vison* PREBLE, North Amer. Fauna, No. 22, p. 66, October 31.
1912. *Mustela vison vison* MILLER, Bull. U. S. Nat. Mus., No. 79, p. 101, December 31.

Type-locality.—Eastern Canada.

Geographic distribution.—Eastern Canada, west to Hudson Bay; south in interior to Catskill Mountains, New York, and to northern Pennsylvania. Not found on the coast south of New Brunswick.

Subspecific characters.—Smallest of the American minks; colors dark. Skull small and comparatively weak and smooth, without well-developed sagittal crest; teeth small.

Measurements of skulls.—Average of 5 skulls of adult males from Quebec and the Adirondack Mountains, New York: Condylobasal length, 65.2; zygomatic breadth, 36.8; least postorbital constriction, 13.1; mastoid breadth, 32.3; length of upper molar-premolar row, 16.9 mm.

Remarks.—The western range of typical *vison* is imperfectly mapped. Where it meets the subspecies *lacustris* and *letifera* can not be stated at present, as good series of skulls from western Ontario, eastern Keewatin, and the middle Great Lakes region, necessary to determine the matter, are not at hand.

Digitized by Google

MUSTELA VISON LUTREOCEPHALA Harlan.

1804. ? *Mustela viningus* BARTON, Trans. Amer. Philos. Soc., vol. 6, p. 70. (*Nomen nudum.*)
1825. *Mustela lutreocephala* HARLAN, Faun. Amer., p. 63.
1858. *M[ustela] rufa* SMITH, Jardines' Nat. Lib., vol. 15, p. 189. (New York.) Not *Mustela rufa* DESMAREST, 1820.
1865. *Vison lutreocephala* GRAY, Proc. Zool. Soc. London, 1865, p. 116.
1896. *Putorius vison lutreocephalus* BANGS, Proc. Boston Soc. Nat. Hist., vol. 27, p. 4, March.
1898. [*Putorius vison*] *lutreocephala* TROUESSART, Cat. Mamm., vol. 1, p. 274.
1903. *Lutreola vison lutreocephalus* PRENTISS, Proc. U. S. Nat. Mus., vol. 36, p. 887, July 6.
1905. *Lutreola vison lutreocephala* OBERHOLSER, Notes Mamm. and Summ. Birds west. North Carolina [Pub. Biltmore Forest School], p. 8, September.
1905. *Lutreola lutreocephala* BAILEY, North Amer. Fauna, No. 25, p. 196, October 24.
1912. *Mustela vison lutreocephala* MILLER, Bull. U. S. Nat. Mus., No. 79, p. 101, December 31.

Type-locality.—Maryland.

Geographic distribution.—Eastern United States, from coast of New England south to North Carolina, and, in the interior, to central Georgia and Alabama; westward through southern Pennsylvania and Ohio to Missouri and northeastern Texas.

Subspecific characters.—Larger and more generally robust than *M. v. vison;* smaller than *M. v. letifera.* Coloration averaging much as in *vison,* possibly slightly darker; darker than in *letifera,* with far less white beneath. Skull much heavier and more angular than in *vison,* with well-developed sagittal crest in adults; smaller than in *letifera.*

Measurements of skulls.—Average of 7 skulls of adult males from Maryland and southeastern New York: Condylobasal length, 68.6; zygomatic breadth, 40.9; least postorbital constriction, 14.8; mastoid breadth, 34.7; length of upper molar-premolar row, 17.8 mm.

Remarks.—This subspecies, the common mink of eastern United States, grades into *letifera* wherever the ranges of the two forms meet. It also blends without break into the smaller Gulf coast form *vulgivaga.* Its intergradation with *vison* and with *lutensis* is not so well shown in the specimens at hand, though the evidence seems sufficient to prove that they must run together. Specimens from the Catskill Mountains seem typical of *vison,* while from Highland Falls, Sing Sing, and from Long Island, New York, are skins and skulls equally typical of *lutreocephala.* In specimens from Maine, however, I believe I can see proof of intergradation. Three specimens from Smiths Island, Virginia, are certainly not typical of either *lutreocephala* or *lutensis,* and appear to be "intermediates."

Digitized by Google

MUSTELA VISON LUTENSIS (Bangs).

1898. *Putorius (Lutreola) lutensis* BANGS, Proc. Boston Soc. Nat. Hist., vol. 28, p. 229, March.

1901. [*Putorius*] *lutensis* ELLIOT, Field Col. Mus. Publ. Zool., vol. 2, p. 340.

1901. *Putorius lutensis* MILLER and REHN, Proc. Boston Soc. Nat. Hist., vol. 30, No. 1, p. 220, December 27.

1912. *Mustela lutensis* MILLER, Bull. U. S. Nat. Mus., No. 79, p. 101, December 31.

Type-locality.—Salt marshes off Matanzas Inlet, St. John County, Florida.

Geographic distribution.—Coast of southeastern United States from South Carolina to Florida.

Subspecific characters.—Size medium; colors pale, russet to clay or reddish-brown; tail short. Skull long and slender; teeth large, tooth row measuring greater than in any existing American mink.

Measurements of skulls.—Average of 5 skulls of adult males from coast of Georgia and South Carolina: Condylobasal length, 71.1; zygomatic breadth, 39.8; least postorbital constriction, 12.2; mastoid breadth, 34; length of upper molar-premolar row, 19.2 mm.

Remarks.—Specimens from Smith's Island, Virginia, though referred provisionally to *M. v. lutreocephala*, show such a strong approach toward *lutensis* that I believe the evidence of intergradation is sufficient to warrant me in treating this remarkable mink as a subspecies. Good series of minks from the immediate seacoast between Smith's Island and Charleston will be necessary before a final understanding of the relationships of these two forms is possible.

MUSTELA VISON VULGIVAGA (Bangs).

1895. *Putorius (Lutreola) vulgivagus* BANGS, Proc. Boston Soc. Nat. Hist., vol. 26, p. 539, author's edition, July 31.

1896. *Putorius vison vulgivagus* BANGS, Proc. Boston Soc. Nat. Hist., vol. 27, p. 5, March.

1896. *Putorius vulgivagus* BANGS, Proc. Boston Soc. Nat. Hist., vol. 27, p. 5, March.

1912. *Mustela vison vulgivaga* MILLER, Bull. U. S. Nat. Mus., No. 79, p. 102 December 31.

Type-locality.—Burbridge, Plaquemines Parish, Louisiana.

Geographic distribution.—Coast of Louisiana and Mississippi. North in the Mississippi River bottoms to northern Louisiana.

Subspecific characters.—Like *M. v. lutreocephala*, but averaging decidedly smaller and somewhat paler.

Measurements of skulls.—Average of 6 skulls of adult males from coast region of Louisiana: Condylobasal length, 65.9; zygomatic breadth, 37.8; least postorbital constriction, 14.2; mastoid breadth, 32; length of upper molar-premolar row, 17.5 mm.

Remarks.—The Louisiana coast mink is simply a small, slightly paler form of *lutreocephala*, with which it intergrades throughout the lower Mississippi River region. Specimens from as far north on the Mississippi River as Burlington, Iowa, show a slight tendency toward *vulgivaga*, while specimens from western Alabama are almost typical of *lutreocephala*.

Digitized by Google

MUSTELA VISON LETIFERA, new subspecies.

1888. *Lutreola vison* BAILEY, Rep. Comm. Agric., 1887, p. 433.

Type-locality.—Elk River, Minnesota. Type-specimen, No. 188305, U.S.N.M., male ad., skin and skull; collected November 7, 1885, by V. Bailey.

Geographic distribution.—From northern Wisconsin and northern South Dakota south to northern Illinois, northern Missouri, and southern Kansas.

Subspecific characters.—Like *Mustela vison lacustris*, but averaging smaller and paler. Skull smaller, less constricted back of postorbital processes and with very much lighter, narrower rostrum.

Measurements.—Total length of type: 660 (26 inches, flesh). Skull of type: Condylobasal length, 69.6; zygomatic breadth, 40.9; least postorbital constriction, 13; mastoid breadth, 35.4; length of upper molar-premolar row, 17.9 mm. Average measurements of five skulls of adult males from Elk River and Fort Snelling, Minnesota: Condylobasal length, 69.3; zygomatic breadth, 39.8; least postorbital constriction, 12.8; mastoid breadth, 35; length of upper molar-premolar row, 17.9 mm.

Remarks.—This is a well-marked subspecies occupying a large area in the upper Mississippi Valley and thence southwest to Kansas. Owing to the lack of good series of adult specimens from the middle Mississippi Valley, the limits of the range of this form to the southeast can not now be defined satisfactorily. In general, the line dividing the ranges of *letifera* and *lutreocephala* runs from the northwestern corner of Indiana to the northeast corner of Missouri, thence southwest to the southeastern corner of Kansas. Larger series, to supplement the scattering material now at hand from this general region, may materially change our ideas of these limits; but there is no trouble in distinguishing the two forms, which, back from the general line of intergradation are represented by large series and are well marked.

MUSTELA VISON LACUSTRIS (Preble).

1902. *Lutreola vison lacustris* PREBLE, North Amer. Fauna, No. 22, p. 66, October 31.

1903. *Putorius vison lacustris* MILLER AND REHN, Proc. Boston Soc. Nat. Hist., vol. 31, No. 3, p. 114, August.

1912. *Mustela vison lacustris* MILLER, Bull. U. S. Nat. Mus., No. 79, p. 101, December 31.

Type-locality.—Echimamish River (near Painted Stone), Keewatin.

Geographic distribution.—Interior of Canada from Great Bear Lake and western shores of Hudson Bay south through Alberta, Saskatchewan, and Manitoba, to southern North Dakota.

Subspecific characters.—Nearest related to *M. v. ingens*, but smaller, slightly paler, and with maximum amount of white beneath. Differs from *M. v. letifera* in its slightly larger size, darker average color, and

Digitized by Google

very broad rostrum. Braincase flat, long, and little rounded posteriorly.

Measurements of skulls.—Average of 8 skulls of adult males from Keewatin: Condylobasal length, 71.5; zygomatic breadth, 42.3; least postorbital constriction, 11.9; mastoid breadth, 37.2; length of upper molar-premolar row, 18.4 mm.

Remarks.—This form, which has an extensive range over the interior of Canada, grades into the still larger *ingens* in the lower Mackenzie Valley; and in the northern United States (northern Minnesota and southern North Dakota) blends into the lighter colored and slightly less robust *letifera*.

MUSTELA VISON ENERGUMENOS (Bangs).

1896. *Putorius vison energumenos* BANGS, Proc. Boston Soc. Nat. Hist., vol. 27, p. 5, March.
1897. *Lutreola vison energumenos* MERRIAM, Mazama, vol. 1, No. 2, p. 227, October.
1912. *Mustela vison energumenos* MILLER, Bull. U. S. Nat. Mus., No. 79, p. 101, December 31.

Type-locality.—Sumas, British Columbia.

Geographic distribution.—Western North America, from northern British Columbia south to the Sierra Nevada Mountains in California and Rocky Mountains in New Mexico.

Subspecific characters.—Size rather small; coloration dark. Skull differs from those of its geographic neighbors, *lacustris*, *nesolestes*, and *letifera*, in its smaller size and small teeth.

Measurements of skulls.—Average of 5 skulls of adult males from British Columbia, Washington, Idaho, and Wyoming: Condylobasal length, 66.2; zygomatic breadth, 38.6; least postorbital constriction, 13.2; mastoid breadth, 33.7; length of upper molar-premolar series, 17.4 mm.

Remarks.—Though commonly referred to as a large form, the measurements of skulls of adult males of this subspecies are exceeded by those of all our minks excepting *vison* and *vulgivaga*, and good series from all parts of the range of *energumenos* bear this out. Intergradation is shown by the specimens at hand only in southeastern Alaska, with *nesolestes;* and in the eastern edge of the northern Rockies, with *lacustris*.

MUSTELA VISON NESOLESTES (Heller).

1909. *Lutreola vison nesolestes* HELLER, Univ. California Publ. Zool., vol. 5, No. 2, p. 259, February 18.
1912. *Mustela vison nesolestes* MILLER, Bull. U. S. Nat. Mus., No. 79, p. 102, December 31.

Type-locality.—Windfall Harbor, Admiralty Island, Alaska.

Geographic distribution.—Alexander Archipelago, Alaska.

Subspecific characters.—Size intermediate between *ingens* and *energumenos;* colors rather dark. Skull with broadly spreading zygo-

Digitized by Google

mata; teeth, especially last upper molar, very large. Measurements of length of upper molar-premolar series exceeded only by those of *lutensis* and *macrodon*.

Measurements of skulls.—Average of 3 skulls of adult males from Admiralty and Baranof Islands: Condylobasal length, 69.7; zygomatic breadth. 41.5; least postorbital constriction, 13.2; mastoid breadth, 34.6; length of upper molar-premolar row, 18.9 mm.

Remarks.—The large teeth readily distinguish this form from its neighbors on the mainland. It apparently intergrades with *energumenos* over the islands of extreme southeastern Alaska and British Columbia.

MUSTELA VISON MELAMPEPLUS (Elliot).

1903. *Putorius vison melampeplus* ELLIOT, Field Col. Mus. Publ. Zool., vol. 3, No. 10, p. 170, April.
1904. *Lutreola vison melampeplus* OSGOOD, North Amer. Fauna, No. 24, p. 45, November 24.
1905. *Putorius melampeplus* ELLIOT, Field Col. Mus. Publ. Zool., vol. 6, p. 425.
1912. *Mustela vison melampeplus* MILLER, Bull. U. S. Nat. Mus., No. 79, p. 102, December 31.

Type-locality.—Kenai Peninsula, Alaska.

Geographic distribution.—Kenai Peninsula and Cook Inlet region, Alaska.

Subspecific characters.—Closely related to *M. v. energumenos*, and of about same size; colors averaging darker and skull with audital bullæ much flattened.

Measurements of skulls.—Average of skulls of 5 adult males from the Kenai Peninsula: Condylobasal length, 66.9; zygomatic breadth, 38.1; least postorbital constriction, 11.4; mastoid breadth, 35; length of upper molar-premolar row, 17.4 mm.

Remarks.—This is a slight form, the least marked of any recognized. Its relationships are close to *M. v. energumenos*, with which it probably blends along the coast. Though specimens from the Alaska Peninsula are placed with *ingens*, these show an approach toward *melampeplus*.

MUSTELA VISON INGENS (Osgood).

1900. *Lutreola vison ingens* OSGOOD, North Amer. Fauna, No. 19, p. 42, October 6.
1901. [*Putorius vison*] *ingens* ELLIOT, Field Col. Mus. Publ. Zool., vol. 2, p. 340.
1901. *Putorius vison ingens* MILLER and REHN, Proc. Boston Soc. Nat. Hist., vol. 30, No. 1, p. 220, December 27.
1912. *Mustela vison ingens* MILLER, Bull. U. S. Nat. Mus., No. 79, p. 101, December 31.

Type-locality.—Fort Yukon, Alaska.

Geographic distribution.—Northern, western, and central Alaska; northern Yukon and northwestern Mackenzie; south to the Alaska Peninsula and to Fort Good Hope, Mackenzie; east to Anderson River.

Digitized by Google

Subspecific characters.—Size largest of the existing forms; colors averaging pale. Skull very large and angular; teeth larger than in any existing forms except *nesolestes* and *lutensis*.

Measurements of skulls.—Average of 5 skulls of adult males from Yukon River, Alaska: Condylobasal length, 74.8; zygomatic breadth, 44.4; least postorbital constriction, 13; mastoid breadth, 39.5; length of upper molar-premolar row, 18.9 mm.

Remarks.—This subspecies, long known as the largest of the existing minks, grades directly into *M. v. lacustris* in the lower Mackenzie Valley, and into *M. v. melampeplus* near the base of the Alaska Peninsula.

MUSTELA MACRODON (Prentiss).

1903. *Lutreola macrodon* PRENTISS, Proc. U. S. Nat. Mus., vol. 26, p. 887, July 6.
1904. [*Putorius*] *macrodon* TROUESSART, Cat. Mamm., Suppl., vol. 1, p. 206.
1911. *Lutreola vison antiquus* LOOMIS, Amer. Journ. Sci., vol. 31, No. 183, p. 228, March. (Flagg Island, Casco Bay, Maine.)
1912. *Mustela macrodon* MILLER, Bull. U. S. Nat. Mus., No. 79, p. 101, December 31.

Type-locality.—Brooklin, Hancock County, Maine.

Geographic distribution.—Known only from fragments of skeletons and teeth found in the "shell-heaps" on the coast of Maine.

Specific characters.—Size, largest of the mink. Skull with wide rostrum, large opening of anterior nares, large antorbital foramina, and very large teeth.

Measurements.—Length of upper molar-premolar row of type-specimen, 21 mm. Measurements of a right mandibular ramus from Lower Babson Island, Maine: Length (estimated), 48; length of lower molar-premolar row, 24.6 mm.

Remarks.—The skull of this species is readily distinguishable from skulls of all the subspecies of *vison* by its large size and by the much larger teeth. The difference is so great that direct comparison or measurements are unnecessary, to separate it from all existing minks.

In Forest and Stream for August 15, 1903, Manly Hardy gives information that makes it seem probable that *Mustela macrodon* did not become extinct until about 1860. Up to that time a large mink from coast islands was recognized as a distinct form by Mr. Hardy's father, Mr. Hardy himself, and other Maine fur buyers. As skins of this giant species were received only from the coast, it was known to the traders as the "sea mink." On account of its large size it brought special prices, and was eagerly sought by hunters and trappers. Hardy describes it as "fully twice as large as the mink from inland, the smallest of them being as large as the largest inland mink and the largest fully twice the size of their inland relatives * * *. The fur was coarse and was of a more reddish color than that of the inland, or as they were called, the 'woods mink,'

Digitized by Google

to distinguish them from the 'sea mink.' The mink which are now taken on our seacoast along Penobscot Bay are quite large and the fur is coarse, but we get none of the great sea mink like those taken 40 or more years ago."

It seems more than probable, therefore, that this species flourished on the Maine islands until comparatively late years, and was exterminated, in its limited distribution, by the modern fur trade.

Measurements of selected adult male skulls of the subspecies of Mustela vison.

U.S.N.M. No.	Name.	Locality.	Condylobasal length.	Zygomatic breadth.	Least postorbital constriction.	Mastoid breadth.	Length of upper molar-premolar row.
			mm.	*mm.*	*mm.*	*mm.*	*mm.*
102571	*M. v. vison*	Lake St. Johns, Quebec	65.0	36.5	15.1	31.6	16.2
188279	do	Adirondack Mountains, New York.	66.5	36.5	12.5	32.5	17.4
188291	do	do	66.0	37.7	13.0	31.6	17.0
188282	do	do	64.0	36.0	12.6	33.0	17.0
188274	do	do	65.4	37.2	12.5	32.6	16.7
155390	*M. v. lutreocephala*	Laurel, Maryland	68.5	38.8	15.7	33.1	18.8
145259	do	do	67.0	41.0	15.6	34.5	17.5
145256	do	do	67.7	42.1	15.2	36.0	18.2
172459	do	Little Patuxent River, Maryland.	69.0	39.9	14.4	35.0	18.0
174764	do	Maryland	67.4	40.6	15.0	33.5	18.5
36915	do	do	71.0	45.0	13.7	37.1	17.5
86234	do	Highland Falls, New York	68.4	38.5	13.9	33.4	17.4
3901	*M. v. lutensis*	Georgia	70.1	39.4	11.2	34.0	19.1
188358	do	Frogmore, South Carolina	69.6	41.0	12.8	33.6	18.2
188359	do	do	71.0	37.6	11.1	32.6	19.0
188362	do	Charleston, South Carolina	71.5	39.9	13.8	36.2	19.1
188361	do	Mount Pleasant, South Carolina.	73.1	41.0	12.0	33.3	18.7
99954	*M. v. vulgivaga*	Calcasieu Parish, Louisiana.	70.2	41.1	15.0	34.4	18.0
99953	do	do	66.5	35.8	14.2	30.7	17.6
99956	do	do	68.0	40.0	13.9	32.6	17.8
99957	do	do	67.2	36.5	15.0	32.1	18.2
136596	do	Iowa, Louisiana	62.6	36.5	13.0	31.4	16.3
136597	do	do	61.0	36.1	14.1	31.0	17.0
188322	*M. v. letifera*	Elk River, Minnesota	71.5	40.8	13.6	36.3	19.5
188305	do	do	69.6	40.9	13.0	35.4	17.9
188324	do	do	67.6	38.6	12.6	33.6	17.6
188316	do	do	66.8	36.2	12.0	32.3	17.2
122509	do	Fort Snelling, Minnesota	71.0	42.6	12.8	37.0	17.2
110146	*M. v. lacustris*	Oxford House, Keewatin	69.6	41.7	11.5	36.0	18.0
110134	do	do	71.2	42.0	10.2	37.0	18.0
110147	do	do	69.7	41.6	13.2	37.0	18.5
110131	do	do	70.9	42.5	13.0	37.8	18.5
115960	do	Cross Lake, Keewatin	73.0	45.6	13.0	38.0	18.9
115953	do	do	71.0	41.2	11.6	37.0	18.0
115952	do	do	73.0	43.6	11.9	38.0	18.6
3284	do	Nelson River, Keewatin	72.6	41.6	10.9	35.5	18.6
84572	*M. v. energumenos*	Chilliwack, British Columbia.	66.7	40.5	13.4	33.5	17.4
188336	do	Chehalis County, Washington.	67.0	39.0	13.6	35.4	17.5
188334	do	Teton Basin, Idaho	66.0	39.0	11.6	34.6	17.0
188335	do	Idaho	66.1	38.0	14.0	33.6	18.0
188339	do	Woods, Wyoming	64.0	36.4	13.2	31.6	17.2
137473	*M. v. nesolestes*	Admiralty Island, Alaska	70.1	41.5	12.2	37.1	19.2
14463	do	Sitka, Alaska	68.5	.....	14.1	33.6	18.5
76703	do	do	70.5	.....	13.4	33.2	18.9
136760	*M. v. melampeplus*	Kenai Peninsula, Alaska	65.5	37.7	11.4	35.0	17.5
136761	do	do	68.5	39.0	12.0	35.0	17.9
136759	do	do	66.1	37.4	10.4	35.2	17.1
136758	do	do	68.2	39.0	12.1	35.8	17.0
136756	do	do	66.0	37.1	11.1	35.9	17.5
6530	*M. v. ingens*	Fort Yukon, Alaska	76.2	47.4	12.6	41.5	19.0
21377	do	Mission, Alaska	77.0	44.0	13.2	38.4	18.5
21366	do	Andreafski, Alaska	73.5	44.0	13.6	40.4	19.1
21370	do	do	74.0	44.0	12.0	38.5	18.5
21357	do	Alaska	73.0	42.6	13.5	38.5	19.5

Digitized by Google

Average measurements of selected adult male skulls of the subspecies of Mustela vison.

No. of specimens averaged.	Name.	Locality.	Condylobasal length.	Zygomatic breadth.	Least postorbital constriction.	Mastoid breadth.	Length of upper molar-premolar row.
			mm.	mm.	mm.	mm.	mm.
5	*M. v. vison*	Quebec and Adirondack Mountains, New York.	65.2	36.8	13.1	32.3	16.9
7	*M. v. lutreocephala*	Maryland and southeastern New York.	68.6	40.9	14.8	34.7	17.8
5	*M. v. lutensis*	Coast of Georgia and South Carolina.	71.1	39.8	12.2	34.0	19.2
6	*M. v. vulgivaga*	Southern Louisiana	65.9	37.8	14.2	32.0	17.5
5	*M. v. letifera*	Fort Snelling and Elk River, Minnesota.	69.3	39.8	12.8	35.0	17.9
8	*M. v. lacustris*	Keewatin	71.5	42.3	11.9	37.2	18.4
5	*M. v. energumenos*	British Columbia, Washington, Idaho, and Wyoming.	66.2	38.6	13.2	33.7	17.4
3	*M. v. nesolestes*	Admiralty and Baranof Islands, Alaska.	69.7	41.5	13.2	34.6	18.9
5	*M. v. melampeplus*	Kenai Peninsula, Alaska	66.9	38.1	11.4	35.0	17.4
5	*M. v. ingens*	Yukon River, Alaska	74.8	44.4	13.0	39.5	18.9

Digitized by Google

A SYNOPSIS OF PART OF THE NEOTROPICAL CRANE-FLIES OF THE SUBFAMILY LIMNOBINÆ.

By CHARLES P. ALEXANDER,

Of the Entomological Laboratory of Cornell University, Ithaca, New York.

INTRODUCTION.

The present paper is the partial result of the study of some extensive collections of tropical American Tipulidæ or crane-flies. In this paper the tribes Eriopterini and Limnophilini are included. A second part will include the tribes Limnobini, Antochini, and Hexatomini, completing the Limnobinæ, and a third will treat of the Tipulinæ.

In this paper the term Neotropical is used as synonymous with the Neogæa (in part), of Sclater (1858) and the Dendrogæa of Sclater (1874). It includes South America and the adjacent Falkland, South Georgia, Juan Fernandez, and Galapagoes Islands; the West Indies, or Antilles; Central America, Mexico, and the extreme southern portions of Florida and Texas.

Besides describing all new forms and redescribing such species as are inadequately handled in previous descriptions, I have thought it might be of some value to future students to include keys to the genera and species of the regional forms. It should be understood, however, that the difficulties in the way of such an attempt are such as to almost discourage one from undertaking it. One must remember that a very considerable number of the species have never been rediscovered since their original description; many of these descriptions are brief, vague, and altogether unsatisfactory. Those of Fabricius would be as bad as those of Walker if it were not for the work of Wiedemann, who had access to the Fabrician types. Philippi, who described a large number of Chilean species, was almost unacquainted with the work of European writers on the subject, and as a result committed some grievous errors, such as erecting the genus *Plettusa* for the well-known *Geranomyia* (and referring it to the Culicidæ), the genus *Idioneura* for the well-known and cosmopolitan *Helobia*; the genus *Polymoria*, based on the misconception that the insect possessed six posterior cells, etc. In addition to insufficient descriptions, a serious difficulty exists in the fact that several score of

PROCEEDINGS U. S. NATIONAL MUSEUM, VOL. 44—NO. 1966.
69077°—Proc.N.M.vol.44—13——31

Digitized by Google

species have been placed in wrong genera, and there many of them remain at the present writing. Until the type is studied, or the species rediscovered, the generic position of many species must be considered in doubt. I have studied this subject with considerable thoroughness and as a result have assigned each of these faulty species to its probable true generic position, and it is in this genus that the species will be considered. Future research will undoubtedly prove that many of the species were wrongly assigned, and the purpose of this introduction is to let the reader know of the difficulties in the way. Many of the keys are based entirely or in part upon the original descriptions, and for that reason it has been necessary to use superficial characters for the main subdivisions, such as "wings spotted," "wings not spotted," etc. This is of course unsatisfactory, but convenient and, under the circumstances, the only possible course.

As an example of the manner in which species are referred to the wrong genera, the case of the genus *Limnobia* is cited. This genus, erected by Meigen in 1803, has served as a storehouse, or junk heap, for species which are in reality referable to almost every genus of the Limnobinæ. The numerous species of Fabricius and Wiedemann were described before the old genus *Limnobia* was split up. Macquart included everything in *Limnobia* that possessed but two branches to the radial sector. Philippi and Gay described a large number of species of what seem to be *Furcomyia*, as *Limnobia*. The notorious work of Francis Walker needs no comment here, most of his descriptions being absolutely unrecognizable and the types of many no longer in existence, many of the names are herein considered as unrecognizable species and dropped from consideration.

After this discussion of the difficulties encountered because of the work of pioneer students like Fabricius and Weidemann, or the miserably poor work of Walker, it is a pleasure to speak of the really monumental labors of Osten Sacken, who, having seen the types of many of the early writers, definitely and finally gave them a true generic position. Of the scores of species of New World crane-flies described by Osten Sacken and his fellow workers, Loew and Schiner, not one can be called "unrecognizable" from their descriptions. Osten Sacken did not describe an extraordinary number of new species, but whatever work he did was done thoroughly and accurately. The "Father of American Dipterology" now rests from his labors, having won the honor, respect, and the highest esteem of every student of his subject.

In studying the Neotropical Tipulidæ the student is struck by the abundance of certain genera and tribes, and the total absence of others. Of the hundreds of specimens examined by the writer not a single species of the Cylindrotominæ or Pedicini was encountered. Limnobini are abundant (*Geranomyia*, *Furcomyia*, and *Rhipidia*);

Digitized by Google

Antochini common, especially *Rhamphidia* and *Teucholabis;* Eriopterini numerous; Limnophilini common (*Limnophila, Polymera,* and *Epiphragma*), Hexatomini very numerous, almost all being Erioceræ; the Tipulinæ are represented by an abundance of *Tipula, Pachyrhina, Brachypremna, Tanypremna,* and *Megistocera.*

GEOGRAPHICAL DISTRIBUTION.

Concerning the geographical conditions of the regions where certain of the included material was collected, the following are of interest:

BRITISH GUIANA.

Toomatoomari.—Cataracts on the Potaro River, 8 miles above the junction with the Essequibo.

Kaieteur (Falls).—Formed by the fall of the River Potaro, a tributary of the Essequibo, over an abrupt cliff of 741 feet. The width of the fall at times of high water is 370 feet while at low water it decreases to rather less than half that width.[1]

The rainy season of November-January was entirely skipped. Ordinarily the lowest water stage of the year is in October, following the so-called long dry season. But in February, when we were there, the river captains and crews on both the Demerara and Essequibo Rivers reported that the water there was the lowest they had ever seen it at any season. Swamps which I made some effort to reach, and which I was assured I would find waist deep in water, were in every case entirely dry, and usually baked and cracked. * * * I believe the time of year to go after both of these groups (Tipulidæ and Syrphidæ) in the Tropics is August or the end of the long rainy season. The end of the short rainy season (December and January) would also be favorable, but this is an uncertain season and has failed in the past, as it did in 1911–12. In fact, the best time for collecting in either Trinidad or British Guiana is during your summer vacation—June, July, and August. It is rather strange that more students in the East, close to New York, do not go South during the summer.[2]

BRAZIL.

Chapada.—A small village of Matto Grosso, Brazil, about 25 miles ENE. of Cuyaba (the capital of Matto Grosso), on the plateau. The village itself is about 2,500 feet above sea level, or 1,800 feet above Cuyaba, but collections are from all the surrounding region as low as 1,500 feet. This is a country of mixed forest and campo, or grassland, with scattered trees; there are many streams—some small lakes or ponds and tracts of more or less boggy savanna where the streams rise. The name Chapada is really a generic application, applied to the plateau in general. The real name of this village is Santa Anna la Chapada, and in some maps it appears as Santa Anna, but in all that region it is known simply as Chapada, or the Chapada.

Corumba.—A town on the River Paraguay, near the junction of the Taguary, the port of entry for Matto Grosso. There is a tract of dry rocky land, a kind of island, in the flood plain of the Paraguay, which is here very extensive. Collections were made principally on the flood plain; the waters were rising, but I used to wade about with a boy pushing a canoe through the grass behind me. These flood plains are mostly open grassland, with some forest along the river and channels.[3] (H. H. Smith.)

[1] From Among the Indians of Guiana, by Everard F. Im Thurn. (1883).

[2] Letter from E. B. Williamson to J. G. Needham, April 23, 1912.

[3] From Contributions to a Knowledge of the Odonata of the Neotropical Region, by P. P. Calvert, Ann. Carnegie Mus., vol. 6, No. 1, 1909.

Digitized by Google

Igarape Assú is about 120 miles from the city of Pará. It is situated about 1,000 feet above the sea level and in the heart of the forest. I arrived at my destination about the first of December, 1911, which is the latter part of the dry season. The rains did not start until about the middle of January, and from then on it rained almost every day for three or four hours. It was usually fine in the morning, but toward 12 o'clock clouds loomed up on the horizon. When these wet days come it is very hard to keep things from molding, especially insects. There were very few Tipulidæ to be had during the dry season, but they became more plentiful as the wet season advanced. I used to go out with a waterproof on and an umbrella in one hand and net in the other. The place where I stopped was right beside a swamp, so that it made it all the better for your material. At night I put a light, mounted on a chair, with a sheet behind it, and this had the desired effect.[1]

It is not proposed nor intended to give the characters of any genus, except where such genera have been insufficiently described. In the case of monotypic genera, described in papers that are difficult of access to the student, the generic and specific descriptions are included. Under each genus is given references to the best characterizations of the genera that are available, some one or more of which will be accessible to the general student of the Diptera. As regards the synonomy of the species, it has been given complete in the case of purely Neotropical forms. In wide-ranging or cosmopolitan species, only the more important or significant changes are given.

For the information of the reader concerning any points of nomenclature that may be doubtful, I give the following bibliography of the systems adopted in this paper:

1. *Wing venation:*

COMSTOCK, J. H., and NEEDHAM, J. G.

The Wings of Insects.

American Naturalist, vol. 32, No. 373, pp. 43–48; No. 374, pp. 81–89; No. 376, pp. 231–257; No. 377, pp. 335–340; No. 378, pp. 413–424; No. 380, pp. 561–565; No. 382, pp. 769–777; No. 384, pp. 903–911; vol. 33, No. 386, pp. 117–126; No. 391, pp. 573–582; No. 395, pp. 845–860.

Published separately by the Comstock Publishing Company with the addition of a table of contents, 124 pp., 90 figs. The fourth part, No. 377, pp. 335–340, deals with the Diptera but makes no mention of the Tipulidæ in particular.

NEEDHAM, JAMES GEORGE.

Crane-flies, in the 23rd Report of the State Entomologist of New York, 1907, pp. 199–248, pls. 11–32. The most complete account and critical study of the venation of crane-flies ever published. The study of this paper is strongly recommended.

2. *Head sclerites:*

COMSTOCK, J. H., and KOCHI, C.

The Skeleton of the Head of Insects.

American Naturalist, vol. 36, No. 421, pp. 13–45.

COMSTOCK, J. H. and KELLOGG, V. L.

The Elements of Insect Anatomy.

Comstock Publishing Company, Ithaca, New York (1904), pp. 1–145.

[1] Letter from H. S. Parish, May 24, 1912.

Digitized by Google

3. *Thoracic sclerites:*
CRAMPTON, G. C.
A Contribution to the Comparative Morphology of the Thoracic Sclerites of Insects.
Proc. Acad. Nat. Sci. Philadelphia, Jan., 1909 (Feb. 22, 1909), pp. 3–54, pls. 1–4.
SNODGRASS, R. E.
The Thorax of Insects and the Articulation of the Wings.
Proc. U. S. Nat. Mus., vol. 36, pp. 511–595, pls. 40–69 (Nos. 1687, 1909).

4. *Abdominal sclerites:*
COMSTOCK, J. H., and KELLOGG, V. L.
The Elements of Insect Anatomy.
Ithaca, N. Y., 1904.

5. *Hypopygial characters:*
SNODGRASS, R. E.
The Hypopygium of the Tipulidæ.
Trans. Amer. Ent. Soc., vol. 30, pp. 179–236, pls. 8–18.

The above are, without much question, the best and are recommended to students of the family as standards to be followed in the describing of species.

Wherever I have asked for specimens, available material was very cheerfully given me for study. I wish to express my sincere gratitude to several gentlemen for their kindness in regard to this matter. These are Mr. Frederick Knab, of the United States National Museum; Mr. J. A. Grossbeck, especially for the loan of the Lutz-Crampton Guiana collection; Mr. S. H. Henshaw of the Museum of Comparative Zoology; Prof. C. F. Baker, Mr. C. W. Johnson, Mr. E. T. Cresson, jr., and others. Much of the work was done as research in the Systematic Entomological Laboratory of Cornell, under the direction of Dr. J. Chester Bradley, and to Doctor Bradley and Doctor Needham, my sincere thanks are due for continual help.

The following collections are embraced in the material studied:

1. United States National Museum, Washington, District of Columbia. A very extensive series of nearly 400 specimens representing about 90 species: received through Mr. Knab.

2. American Museum of Natural History, New York City. A collection embracing about 50 specimens in 37 species; received through Mr. Grossbeck.

3. Museum of Comparative Zoölogy, Cambridge, Massachusetts. A collection of six specimens, four species, but of especial interest as belonging to the Osten Sacken and Loew collections; received through Mr. S. H. Henshaw.

4. Boston Society of Natural History, Boston, Massachusetts. A specimen of *Tanypremna;* received through Mr. C. W. Johnson.

5. Academy of Natural Sciences, Philadelphia, Pennsylvania. A collection of about 25 specimens, 5 or 6 species; received through Mr. Cresson.

Digitized by Google

6. Cornell University, Ithaca, New York. The rather extensive collections made by Mr. Parish in the Province of Pará, Brazil, in January and February, 1912.

7. Pomona College, Claremont, California. A collection of 5 specimens, 3 species, from Mexico; received through Prof. C. F. Baker.

8. Museu Rocha, Ceara, Brazil. Ten specimens of a *Geranomyia;* received from Mr. P. Rocha.

9. Staudinger and Bang-Haas, Dresden, Germany. A collection of South American species; 22 specimens, 15 species; in author's collection.

10. Mr. E. B. Williamson, Bluffton, Indiana. Ten specimens, representing 3 species, collected by Mr. Williamson on his recent trip (see p. 483); in author's collection.

In a very recent paper,[1] Dr. G. Enderlein has added much to our knowledge of tropical crane-flies. The specific descriptions and the figures are excellent, but the very free erection of genera must be criticized. Of the 15 genera proposed in this paper, several are rank synonyms of older genera, while the majority of the others are based on trivial differences of venational or antennal characters. In regard to this subject it may be well to quote the words of Osten Sacken,[2] as follows:

> To these successors I am free to give a piece of advice, as the result of more than 30 years' experience with the Tipulidæ, and this is not to introduce new genera prematurely. Large accessions of new forms, or of variations of already well-known forms, must be expected from as yet unexplored, principally tropical, regions; but these accessions although large will be slow in coming. Do not introduce new genera for every slight deviation from a well-known type, because you would soon have no end of new genera and a growing difficulty in discriminating between them. But do not hesitate to establish a new genus for a form that can not be forced into any of the existing genera and which shows distinctive characters in more than one organ of its body. Such forms are not very common.

The opinion that I have formed of Enderlein's genera, after a careful study of their characters, is given below. Mr. F. W. Edwards, the well-known British authority on the Limnobinæ, writes me that, in his opinion also, most of the Enderlein genera rest on a very insufficient basis.

1. *Ctenacroscelis* (p. 1) equals *Holorusia* Loew. (*H. rubiginosa* Loew has cross-vein *r* present in normal individuals, and connected with R_{2+3} instead of R_2.)

2. *Icriomastax* (p. 9) may be a valid genus, although the characters on which it is based are rather trivial.

[1] Günther Enderlein. Studien über die Tipuliden, Limnobiiden Cylindrotomiden, und Ptychopteriden, Zoölogische Jahrbücher. Abteilung für systematik, geographie und Biologie der Tiere, 1912, vol. 32, pt. 1, pp. 1–88, fig. 51.

[2] Osten Sacken, Studies on Tipulidæ, pt. 2, Berlin. Ent. Zeitschr., vol. 31, p. 163.

Digitized by Google

3. *Stegasmonotus* (p. 11) equals *Tanypremna* Osten Sacken. (*Tipula longipes* Fabricius (p. 13) is certainly a *Tanypremna*.)

4. *Pehlkea* (p. 15), apparently a good genus, based, principally, on the strong supernumerary cross-vein in cell M.

5. *Phacelodocera* (p. 26) equals *Ptilogyna*. The differences between this and the Australian Ptilogynæ are not sufficient for generic separation.

6. *Tipulodina* (p. 30), not a *Pedicine*, but unquestionably a Tipuline as shown by the position of Sc_2, shape of cell Cu_1, etc.

7. *Androclosma* (pp. 34–37, 49); not different from *Arrhenica*, proposed by Osten Sacken for *A. spinosa* Osten Sacken. Mr. Edwards informs me that *A. ornatum* has a strange resemblance to a species of *Macromastix* from New Zealand.

8. *Psaronius* (p. 50) equals *Lecteria* Osten Sacken. I have both of Enderlein's species, *Dactylolabis conspersa* (p. 49) and *Psaronius lituratus* (equals *Lecteria obscura* Fabricius). I believe that the presence or absence of tibial spurs is a character that is overdone, as closely related species tend to be separated by it.

9. *Aldrovandia* (p. 52), not Eriopterine, but undoubtedly a Tipuline.

10. *Clydonodozus* (p. 57). Mr. Edwards writes: "I should doubt very much if *Clydonodozus* can be retained as distinct from *Conosia*."

11. *Mongomella* (p. 61) equals *Mongoma* Westwood. The following errata in venational interpretation: *M. cariniceps* (p. 60, fig. L^1), vein R_{2+3} should be R_2; vein M_1 should be R_{4+5}; M_2 should be M_{1+2}; the same applies to *M. gracilis* (p. 62, fig. M_1), which is closely related to *M. zambesiæ* Alexander from East Africa.

12. *Pycnocrepis* (p. 65) equals *Styringomyia* Loew.

13. *Stibadocera* (p. 83) is very doubtfully Cylindrotomine; the presence of Sc_2 and obliteration of Sc_1 is a Tipuline character. The wide separation at the wing-margin of R_1 and R_{2+3} is not at all Cylindrotomine. The position of this very curious genus must remain in doubt until related forms, or more material, are discovered. An examination of the male genitalia would tell whether or not the species belong to the Cylindrotominæ.

New names proposed.—The following new names are given to certain of the species occurring in the list in part 2. The same combination of generic and specific terms necessitates the renaming of the later species.

Geranomyia enderleini, new name for *G. annulata* Enderlein (1912); not *G. annulata* Skuse (1888) (Dipt. Aust., pt. 7, p. 70).

Geranomyia philippii, new name for *G. virescens* Philippi (1865); not *G. virescens* Loew. (1851).

Furcomyia chilensis, new name for *Limnobia guttata* Philippi (1865); not *L. guttata* Meigen (1838) (=*Linnophila marmorata* Meigen).

Digitized by Google

Furcomyia bigoti, new name for *Limnobia longicollis* Bigot (1888); not *L. longicollis* Macquart (1846).

Furcomyia blanchardi, new name for *Limnobia stictica* Blanchard (1852); not *L. stictica* Meigen (1818).

Furcomyia subandina, new name for *Limnobia stigmatica* Blanchard (1852); not *L. stigmatica* Meigen (1830).

Epiphragma fabricii, new name for *Tipula maculata* Fabricius (1805); not *T. maculata* Linnæus (1758); not *T. maculata* Meigen (1804).

Eriocera willistoni, new name for *E. fasciata* Williston (1900); not *E. fasciata* Guerin (1830).

Eriocera longistyla, new name for *Tipula erythrocephala* Fabricius (1805); not *T. erythrocephala* De Geer (1776).

I wish, in closing this introductory statement, to express my thanks to Mr. F. W. Edwards, of the British Museum of Natural History, for the following information regarding Walker's South American Tipulidæ:

Limnobia calopus Walker. Types ♂ ♀ in very good condition, only one leg missing from each. Osten Sacken has a note attached, "Comp. this to *Limnobia armillaris* Wied. (O. Sack)." Certainly belongs to the genus *Lecteria*, but there is no cross vein in the second submarginal cell.

Limnobia reciproca Walker. Bad condition; no legs. Genus *Trimicra* (close to *T. pilipes* Fabr.).

Limnobia chrysoptera Walker. No legs, but recognizable by wings, easily I should say. Genus *Eriocera*.

Limnobia tenebrosa Walker. Good condition; genus *Eriocera*.

Gonomyia variegata Walker is a *Geranomyia*.

Gonomyia antarctica Walker is a *Limnophila*.

Ptilogyna simplex Walker. Fair condition; genus *Ozodicera*, as stated by O. S.

Tipula filigera Walker. Fair condition; certainly recognizable. I have not studied the Tipulinæ and am not sure of the genus of this. The legs are very long and slender, but the venation is like *Tipula*, the anterior branch of the second vein (R_2) being oblique. Antennæ, 10-jointed?

The other species you ask about I can not trace in our collection, so their existence is doubtful.

A LIST OF THE NEOTROPICAL TIPULIDÆ (LIMNOBINÆ).

Tribe 1.—LIMNOBINI:

Geranomyia brasiliensis Westwood.
G. enderleini, new name (for *annulata* Enderlein).
G. fulvithorax Philippi.
G. insignis Loew.
G. intermedia Walker.
G. leucomelanopus Enderlein.
G. lineata Enderlein.
G. mexicana Bellardi.
G. pallida Williston.

Tribe 1.—LIMNOBINI—Contd.

G. philippii, new name (for *virescens* Philippi).
G. pilipes Walker.
G. rostrata Say.
G. rufescens Loew.
G. stigmatica Philippi.
G. testacea Philippi.
G. tibialis Loew.
G. tristis Loew.
G. valida Loew.

Digitized by Google

Tribe 1.—LIMNOBINI—Contd.

G. variegata Walker.
G. virescens Loew.
Rhipidia annulicornis Enderlein.
R. bipectinata Williston.
R. costalis Williston.
R. domestica Osten Sacken.
R. subpectinata Williston.
R. tabescens Enderlein.
R. unipectinata Williston.
Peripheroptera aberrans Schiner.
P. incommoda Osten Sacken.
P. nitens Schiner.
P. schineri Osten Sacken.
Discobola argus Say.
Furcomyia bigoti, new name (for *longicollis* Bigot).
F. blanchardi, new name (for *stictica* Blanchard).
F. chilensis, new name (for *guttata* Philippi).
F. chlorotica Philippi.
F. elquiensis Philippi.
F. flavida Philippi.
F. infumata Philippi.
F. lineicollis Blanchard.
F. muscosa Enderlein.
F. ornatipennis Blanchard.
F. pallida Macquart.
F. phatta Philippi.
F. polysticta Philippi.
F. subandina, new name (for *stigmatica* Blanchard).
F. vernalis Philippi.
Limnobia ocellata Röder.
?L. diva Schiner.
?L. insularis Williston.
?L. longimana Fabricius.
Zalusa falklandica Enderlein.

Tribe 2.—ANTOCHINI:

Rhamphidia albitarsis Osten Sacken.
Teucholabis annulata Williston.
T. chalybeiventris Loew.
T. complexa Osten Sachen.
T. flavithorax Wiedemann.
T. gracilis Osten Sacken.
T. melanocephala Fabricius.
T. molesta Osten Sacken.
T. morionella Schiner.
T. polita Osten Sacken.
T. rostrata Enderlein.
T. scapularis Macquart.
T. schineri Enderlein.
T. simplex Wiedemann.

Tribe 2.—ANTOCHINI—Contd.

T. spinigera Schiner.
T. trifasciata Enderlein.
T. venezuelensis Macquart.
Toxorrhina brasiliensis Westwood.
T. fragilis Loew.
Elephantomyia meridionalis, new name (for *longirostris* Williston), preocc. fossil.
Diotrepha concinna Williston.
D. mirabilis Osten Sacken.
Paratropeza collaris Osten Sacken.
P. fasciolaris Wiedemann.
P. pæusta Osten Sacken.
P. singularis Schiner.

Tribe 3.—ERIOPTERINI:

Molophilus guatemalensis, new species.
M. thaumastopodus, new species.
Eroptera (*Mesocyphona*) *caloptera* Say.
E. (*M.*) *c.* var. *femoranigra*, new subspecies.
E. (*M.*) *annulipes* Williston.
E. (*M.*) *bicintipes*, new species.
E. (*M.*) *costalis*, new species.
E. (*M.*) *eiseni*, new species.
E. (*M.*) *immaculata*, new species.
E. (*M.*) *knabi*, new species.
E. (*M.*) *parva* Osten Sacken, *brasiliensis*, new subspecies.
E. (*M.*) *splendida*, new species.
E. (*Empeda*) *nigrolineata* Enderlein.
E. (*E.*) *n.* var. *pubescens*, new subspecies.
?E. longipes Philippi.
?E. pallida Philippi.
?E. uniformis Blanchard.
Trimicra anomala Osten Sacken.
T. reciprocra Walker (=*anomala* Osten Sacken?).
Symplecta macroptera Philippi (=*hybrida* Meigen?).
S. hybrida Meigen.
Gnophomyia caloptera Osten Sacken.
G. ferruginea Williston.
G. hirsuta, new species.
G. luctuosa Osten Sacken.
G. magnifica, new species.
G. nigrina Wiedemann.
G. osten-sackeni Skuse.
G. rufithorax Wiedemann.
G. subhyalina, new species.
Gonomyia (*Gonomyia*) *delicata*, new species.

Digitized by Google

Tribe 3.—ERIOPTERINI—Contd.

G. (*Leiponeura*) *pleuralis* Williston.
G. (*L.*) *puella* Williston.
G. (*L.*) *puer*, new species.
G. (*Gonomyia*) *unicolor*, new species.
Sacandaga parva, new species.
Mongoma disjuncta, new species.
M. extensa, new species.
M. longifusa, new species.
M. manca Williston.
M. niveitarsis, new species.
M. pallida Williston.
Cryptolabis tropicalis, new species.
Sigmatomera amazonica Westwood.
S. flavipennis Osten Sacken.
Lecteria armillaris Fabricius.
L. conspersa Enderlein.
L. matto grossæ, new species.
L. obliterata, new species.
L. obscura Fabricius.

Tribe 4.—LIMNOPHILINI:

Epiphragma adspersa Wiedemann.
E. buscki, new species.
E. circinata Osten Sacken.
E. delicatula Osten Sacken.
E. fabricii, new name (for *maculata* Fabricius).
E. histrio Schiner.
E. imitans, new species.
E. nebulosa Bellardi.
E. punctatissima Wiedemann.
E. pupillata, new species.
E. sackeni Williston.
E. varia Wiedemann.
Limnophila apoecila Philippi.
L. chilensis Philippi.
L. cineracea Philippi.
L. epiphragmoides, new species.
L. eutæniata Bigot.
L. flavicauda Bigot.
L. guttulatissima, new species.
L. lentoides, new species.
L. luteipennis Osten Sacken.
L. nacrea, new species.
L. stigmatica Philippi.
L. tenuipes Say.
L. undulata Bellardi.
L. venosa Philippi.
L. verecunda Philippi.
?L. cinerea Philippi.
?L. decasbila Wiedemann.
?L. irrorata Philippi.
?L. lutea Philippi.
?L. multipunctata Fabricius.
?L. pallens Philippi.

Tribe 4.—LIMNOPHILINI—Contd.

?L. punctipennis Philippi.
?L. tenella Philippi.
?L. trichopus Philippi.
L. antarctica Walker.
Ctedonia bicolor Philippi.
C. bipunctata Philippi.
C. flavipennis Philippi.
C. fusca Jænnicke (=*flavipennis* Philippi?).
C. pictipennis Philippi.
Polymera albitarsis Williston.
P. conjuncta, new species.
P. fusca Wiedemann.
P. georgiæ Alexander.
P. grisea, new species.
P. hirticornis Fabricius.
P. inornata, new species.
P. niveitarsis, new species.
P. obscura Macquart.
P. pleuralis, new species.
P. superba, new species.
P. thoracica, new species.
Ischnothrix ætherea Bigot.

Tribe 5.—HEXATOMINI:

Eriocera braconides Enderlein.
E. brunneipes Williston.
E. caminaria Wiedemann.
E. chrysoptera Walker.
E. erythræa Osten Sacken.
E. fasciata Guèrin.
E. flavida Williston.
E. gracilis Osten Sacken.
E. hæmorrhoa Osten Sacken.
E. lessepsi Osten Sacken.
E. longistyla, new name (for *erythrocephala* Fabricius).
E. macquarti Enderlein.
E. melanacra Wiedemann.
E. mesoxantha Osten Sacken.
E. nigra Wiedemann.
E. obsoleta Williston.
E. ohausiana Enderlein.
E. pretiosa Osten Sacken.
E. tænioptera Wiedemann.
E. trifasciata Röder.
E. virgulativentris Enderlein.
E. willistoni, new name (for *fasciata* Williston).
E. zonata Osten Sacken.
?E. flaviceps Wiedemann.
?Penthoptera fuliginosa Schiner.

Tribe 6.—PEDICINI:

?Tricyphona pusilla Bigot.

Digitized by Google

CHARACTERIZATIONS OF NEW SPECIES AND KEYS TO THE FORMS.

KEY TO THE SUBFAMILIES OF TIPULIDÆ.

1. Terminal segment of the maxillary palpi very long, whip-lash shaped, much longer than all of the preceding segments combined; Sc ends in R, Sc_1 being obliterated; fusion of Cu_1 on M usually slight, often punctiform; cell Cu_1 of the wings usually broader at the base than at the middle. Antennæ 13-segmented.....TIPULINÆ.

   Terminal segment of the maxillary palpi short, scarcely longer than the two preceding combined; Sc ends in C, Sc_1 being present; fusion of Cu_1 on M usual long; cell Cu_1 of the wings usually only as broad at the base as at the middle. Antennæ 14 or 16 segmented.....LIMNOBINÆ.

The exceptions to the above characterizations are numerous, but the majority should hold. *Pedicia*, a Limnobine, has long maxillary palpi like the longipalpous Tipulinæ; the Dicranotæ (Pedicini) have 13-segmented antennæ, etc.

KEY TO THE TRIBES OF LIMNOBINÆ.

1. R_s with two branches reaching the margin..... 2.
   R_s with three branches reaching the margin..... 4.
2. Antennæ 14-segmented.....LIMNOBINI.
   Antennæ 16-segmented..... 3.
3. R_1 usually incurved toward R_{2+3} at the wing margin and fused backward with it; tibiæ with spurs at the tip.....CYLINDROTOMINI.
   R_1 runs straight to the wing margin, not fusing with R_{2+3}; tibiæ spurless. ANTOCHINI.
4. Tibiæ spurred at the tip..... 5.
   Tibiæ without spurs at the tip.....ERIOPTERINI.
5. Antennæ with from 6 to 10 segments.....HEXATOMINI.
   Antennæ with from 13 to 39 segments..... 6.
6. Sc_2 retracted far toward the base of the wing so that it is proximad of the origin of R_s.....PEDICINI.
   Sc_2 at the tip of Sc, or retracted backward (*Trichocera*), not proximad of the origin of R_s.....LIMNOPHILINI.

The tribes herein considered, Eriopterini and Limnophilini, are exceedingly closely allied to one another, and the character of the tibial spurs can not, apparently, be depended upon in critical cases. The members of these tribes require further study at the hands of some student who has access to collections where a majority of the forms are contained. If these tribes are valid (and no one disputes the point as to whether they are convenient to use or not), then other characters will be found to separate them. I have included the genus *Lecteria* in both tribes, as *L. obscura* has spurred tibiæ whereas *L. armillaris* has naked, spurless tibiæ.

Digitized by Google

KEY TO THE GENERA OF THE ERIOPTERINI.

(Based largely on Needham's Key, 1907.)

1. Wings absent ..... *Chionea* Dallman.
   Wings present ..... 2.
2. Three branches of M reach the wing-margin ..... 3.
   Two branches of M reach the wing-margin ..... 4.
3. Sc very long; Sc_1 and R_1 approximated at their tips ..... *Lecteria* Osten Sacken.
   Sc shorter; Sc_1 and R_1 distant at their tips ..... *Cladura* Osten Sacken.
4. R_2 shorter than R_{2+3} ..... 5.
   R_2 longer than R_{2+3} ..... 8.
5. Cross vein *r-m* absent; Sc_1 very long, approximating R_1 at their tips; cross vein *r* present ..... *Mongoma* Westwood.
   Cross vein *r-m* distinct; Sc_1 short; no cross vein *r* [1] ..... 6.
6. Antennæ of the male as long as the body, prominently haired .. *Lachnocera* Philippi.
   Antennæ of the male short, normal ..... 7.
7. Sc short ending opposite, or anterior to, the origin of Rs; anal angle of the wing not prominent ..... *Gonomyia* Megerle.
   Sc long ending near to the fork of Rs; anal angle of the wing prominent. *Sacandaga* Alexander.
8. Rs long, normal in position; cell first R_1 elongated ..... 9.
   Rs shortened, its first fork angulated; cell first R_1 equilateral or nearly so. *Cryptolabis* Osten Sacken.
9. Second fork of the radial sector on the posterior side, i. e., Rs ends in cell R_2. *Molophilus* Curtis.
   Second fork of the radial sector on the anterior side, i. e., Rs ends in cell R_3 ..... 10.
10. A supernumerary cross vein in cell R_2; second anal vein strongly bisinuated. *Helobia* Le Peletier.
    No supernumerary cross vein in cell R_2; second anal not bisinuated ..... 11.
11. Cu_1 tending to turn toward the apex of the wing ..... *Erioptera* Meigen.
    Cu_1 tending to turn away from the wing apex ..... 12.
12. Antennal segments (male) subreniform, nodose; fourth antennal segment like a recumbent S ..... *Sigmatomera* Osten Sacken.
    Antennal segments of the male not so ..... 13.
13. Sides of cell first M_2 parallel; Sc_2 near tip of Sc_1 ..... *Gnophomyia* Osten Sacken.
    Sides of cell first M_2 divergent distad; Sc_2 retracted toward the wing basis ..... 14.
14. The deflected base of Cu_1 meets M far before the fork; Rs long and straight at its origin; second fork of Rs skewed forward; terminal 3 segments of the antennæ usually abruptly smaller ..... *Trimicra* Osten Sacken.
    The deflected base of Cu_1 meets M usually at the fork; Rs shorter, straight; second fork of Rs usually symmetrical; flagellar segments of the antennæ uniform. *Rhypholophus* Kolenati.

I have omitted *Polymoria* Philippi from this key as it is very probably a *Limnophila* (See Limnophilini).

[1] Subgenus *Empeda* (genus *Erioptera*) would run down here, but has cross vein *r* present.

Digitized by Google

DESCRIPTIONS OF GENERA AND SPECIES.

Genus LECTERIA Osten Sacken.

Lecteria OSTEN SACKEN, Studies, etc., 1887, pt. 2; Berl. Ent. Zeitschr., vol. 31, p. 206.

Psaronius ENDERLEIN, Zoöl. Jahrb., vol. 32, 1912, pt. 1, pp. 50, 51.

I have included in this genus *Limnobia armillaris* Fabricius, made the type of this genus by Osten Sacken, and which has spurless tibiæ; *Psaronius lituratus* Enderlein (=*Tipula obscura* Fabricius) and *Lecteria obliterata*, new species, which have spurred tibiæ. As I have stated in a later paragraph, I believe that the tibial spur character has been overdone. The venation of these three species is so remarkably similar that I have no hesitation, in view of the existing data, in referring all three species to the genus *Lecteria*.

Lecteria is sufficiently well distinguished, venationally, in the extreme length of subcosta, the long radial sector, strongly arcuated at its origin and thence running parallel with radius, the tendency for R_2 to shorten and disappear, etc. The described species are all Neotropical, but Mr. Edwards informs me that the British Museum possesses three undescribed species from Africa. I believe that the presence or absence of spurs, in this group of species, has the tendency to separate from one another species that are in reality closely allied. Thus Enderlein described as Limnophilini two species which possessed tibial spurs. The type of the genus *Lecteria, armillaris* Fabricius, seems to vary considerably in venation. The specimens upon which Osten Sacken based his genus possessed a supernumerary cross vein in cell R_3, and in some specimens another in cell R_5. The types of *Limnobia calopus* Walker in the British Museum, as well as the three specimens I possess, entirely lack these cross veins. It is probably a case comparable to the related genus *Cladura* Osten Sacken where cross veins may occur almost anywhere on the wing disk.[1]

KEY TO THE SPECIES OF LECTERIA.

1. Wings without distinct markings (antennæ with the basal segments yellow, flagellum black).....*obliterata*, new species. (Guiana)
   Wings with brown markings.....2.
2. Wings with abundant brown dots in all of the cells..*conspersa* Enderlein[2] (Brazil).
   Wings with the markings larger and confined to the neighborhood of the veins.....3.
3. Wing markings confined to a spot at the base of Rs, along deflection of R_{4+5}, and in cell second R_1; cell first M_2 is hexagonal, the fusion of Cu_1 and M_2 slight, less than cross vein *r–m*.....*obscura* Fabricius[3] (Guiana–Brazil).
   Wing-marking more extensive.....4.

[1] See Alexander and Leonard, Venational Variation in Cladura, Jour. N. Y. Ent. Soc., vol. 20, Mar., 1912, pp. 36–39, pl. 4.

[2] Zool. Jahrbuch., 1912, vol. 32, pt. 1, Stud. über die Tipuliden, etc., pp. 49, 50 (fig. D^1) (as *Dactylolabis*).

[3] Syst. Antl., 1805, p. 27 (as *Tipula*); Wiedemann, Auss. Zweifl. Ins., 1828, vol. 1, p. 24 (as *Limnobia*).

Digitized by Google

KEY TO THE SPECIES OF LECTERIA—continued.

4. Wing-markings present as a narrow seam along the cord; at fork of M_{1+2}, R_{2+3}, at origin of Rs, at origin of the basal deflection of R_{4+5}, and at the tips of R_1 and R_2; cell first M_2 pentagonal; basal deflection of Cu_1 before fork of M; basal deflection of R_{4+5} long, longer than M_1..... *matto-grossæ*, new species (Brazil).
Wing markings more extensive; a transverse band across the wing in the neighborhood of the cord; an interrupted band beginning at origin of Rs; tip of wing dark; basal deflection of Cu_1 beyond fork of M; basal deflection of R_{4+5} short; arcuated, less than M_1..... *armillaris* Fabricius[1] (Costa Rica–Brazil).

LECTERIA OBLITERATA, new species.

Small, slender; basal antennal segments yellow; flagellum black; general color of the body dull black; legs brown; wings dark-colored, gray.

Male.—Length, 14.4 mm; wing, 11 mm. Head: Rostrum and palpi dark brown; antennæ, basal segments elongate-cylindrical, stout, second rounded; flagellum, segments rapidly becoming smaller toward the tip; basal segments light yellow; flagellar segments abruptly dark, black. Front dark brown, shiny; vertex black, pollinose on the sides; one or two hairs on the sides of the vertex behind the eyes, occiput with a brown bloom; genæ more yellowish.

Thorax: pronotum, scutum and scutellum visible from above, dull brownish-black. Mesonotum, præscutum with the pseudosutural fovea shallow, but prominent, shiny black; præscutum, extreme cephalic margin with a yellowish bloom which is continued backward on the sides of the sclerite; dorsum of the sclerite velvety-black at the anterior prominence; dull black back to the suture; scutum, scutellum, and post-notum black, rather dusted with light gray. Pleuræ light gray; prothoracic pleuræ somewhat darker, blackish; an indistinct brown stripe across the pleuræ from the fore-coxa to the base of the halteres. Halteres short, stem pale, knob brown. Legs: coxæ and trochanters light brownish-yellow; femora dark brown, more yellow basally; tibiæ and tarsi dark brown. Wings dull brownish-gray; cells C and Sc yellow; veins Sc and R yellow; remaining veins dark brown. Venation (see fig. 41).

Abdomen very elongate; tergum brownish; segments dull yellow at the base and tip, remainder dark grayish-brown; basal sternites yellow, apical ones concolorous with the tergites.

Habitat.—Holotype.—Male, Tukeit, British Guiana, July 21, 1911 (Lutz, coll.). *Paratype.*—Male, Kaieteur Falls, British Guiana, Aug. 10, 1911 (Lutz, coll.).

Types.—In American Museum of Natural History.

[1] Syst. Antl., 1805, p. 26 (as *Tipula*); Wiedemann, Auss. Zweifl. Ins., 1828, vol. 1, p. 13 (as *Limnobia*).

Digitized by Google

LECTERIA CONSPERSA Enderlein.

Dactylolabis conspersa ENDERLEIN, Zool. Jahrb., pt. 1, 1912, pp. 49, 50.

I have seen a single specimen, taken at Rio de Janeiro in November. (Probably by H. H. Smith.) It forms part of the Williston collection in the American Museum of Natural History in New York.

The wing seems to be of a different shape from that shown in Enderlein's figure, almost *Drepanopteryx* or *Osmylus*-like (Hemerobiidæ, Neuroptera).

LECTERIA OBSCURA Fabricius.

Tipula obscura FABRICIUS, Syst. Antl., 1805, p. 27.
Limnobia obscura WIEDEMANN, Dipt. Exot., vol. 1, 1821, p. 12; Auss. Zweifl. Ins., vol. 1, 1828, p. 24.—HUNTER, Trans. Amer. Ent. Soc., vol. 26, 1900, p. 289.—KERTESZ, Cat. Dipt., vol. 2, 1902, p. 175.
Psaronius lituratus ENDERLEIN, Zool. Jahrb., 1912, pp. 50, 51, fig. E_1.

Female.—Length, 23.4 mm.; wing, 15.8 mm.; abdomen, 18.6 mm.; legs, fore, femora 8.8 mm.; tibia 10 mm.; tarsus 1, 5.5 mm.; tarsus 2–5, 3.6 mm.; middle, femora 10.1 mm.; tibia 10.1 mm.; tarsus 1, 4.8 mm.; tarsus 2–5, 3.2 mm.; hind, femora 11.2 mm.; tibia 11.4 mm.; tarsus 1, 3.6 mm.; tarsus 2–5, 3.2 mm.

Head: rostrum and palpi dark brown; palpal segments short; clypeus yellowish-brown, with two long hairs on either side. Antennæ: first segment much elongated, cylindrical, longer than the following three combined; second segment short, rounded-oval, truncated at its apical end; segments of the flagellum gradually more slender and more elongated, clothed with dense, appressed downy hairs and with long hairs which are shortest on the proximal segments; antennæ yellowish-brown; flagellum darker, brown. Front brown; vertex yellowish-brown, rather darker in places; a patch of long hairs on either side of the eye.

Thorax: pronotum brown; mesonotum: præscutum, with a broad deep pseudosutural fovea on its antero-lateral margin; the caudal margin of the fovea gentle, cephalic margin precipitous, dark brown, conspicuous; præscutum light brownish-yellow with indistinct brown stripes; two parallel ones on either side of the pale narrow median stripe, becoming indistinct near the transverse suture; the shorter, but broader, lateral stripes begin just behind the fovea and run backward across the suture; scutum, scutellum, and postnotum dull yellowish-brown, the color of the scutum near the center brought about by the spreading out of the lateral præscutal stripes. Pleuræ dull yellow, a darker spot on the mesothoracic epipleura. Halteres, stem yellow, gradually darkening to the brown knob. Legs: light yellow; femora dark brown at the tip; tibia brown at the extreme base and tip; tarsal segments dull yellow, darker at the tip of each segment; segments four and five brown.

Digitized by Google

Wings: cells C and Sc light yellow, remainder subhyaline; veins brown except where covered by spots; brown spots located as follows: a rounded oval spot at base of Rs, a spot in stigmal area in cell second R_1, a triangular spot along the deflection of R_{4+5}. Venation: Sc, long, as in the subgenus; space on costa between Sc_1 and R_1 shorter than the crossvein *r–m*. Rs extremely arcuated at its origin, then running parallel with R_1 and in a direct line with R_2; R_2 short, tending to be abortive; basal deflection of M_{1+2} shorter than the basal deflection of M_3; M_3+Cu_1 shorter than *r–m*.

One female, Savannah, North Brazil; Aug. 23, 1911 (Crampton, coll.). (Amer. Mus. of Nat. Hist. Coll.)

Two males, Igarape-Assú, Pará, Brazil; Feb. 4, 1912 (Parish, coll.).

One male, one female, Igarape-Assú, Pará, Brazil; Jan. 29, 1912 (Parish, coll.).

Specimens in Cornell University collection; one in author's collection.

LECTERIA MATTO-GROSSÆ, new species.

Head grayish; thorax with three dark brown stripes; pleuræ gray, with a brown stripe; abdomen light brown, with brown edges to the sclerites.

Length (abdomen broken) of head and thorax, 4.8 mm.; wing 13 mm.

Head: rostrum and palpi dark brown; antennæ, first segment, elongate-cylindrical, second, globular, cyathiform; remainder, short, oval, gradually more slender and cylindrical, armed with long hairs, brown. Front and vertex with a greyish-yellow bloom, clearer gray on the occiput; vertex armed with numerous prominent brown hairs, scanty or wanting along the median line.

Thorax: pronotum pale whitish-yellow, the anterior border of the scutum rather more brownish; mesonotum: præscutum, pseudosuture reduced to a narrow impressed line, shaped somewhat like an interrogation point, anteriorly brown, posteriorly, and a rounded area near the pseudosuture greyish-yellow, extreme cephalic margin of the sclerite gray; a narrow dark brown median stripe; a broader brown lateral stripe, anteriorly close to the median vitta, beyond the pseudosuture divergent toward the lateral margin of the sclerite; scutum light grayish-brown, lateral margin dark chestnut-brown, a continuation of the broad lateral præscutal stripes; scutellum and postnotum dull yellow, with a narrow, indistinct brown median stripe. Pleuræ yellowish, with a gray bloom; a dark brown stripe extending from the sternal region of the head across the pleuræ, encroaching on the base of the fore coxa, and extending to beneath the wing-basis. Halteres short, stem yellowish, knob rather browner. Legs, coxæ pale whitish-yellow; trochanters yellow (rest of legs missing).

Digitized by Google

Abdomen: tergum dull yellow, tip of each segment light brown; lateral margin of the sclerites broadly dark brown. (Terminal segments broken.) Sternum pale whitish, a narrow yellow median stripe, which sub-apically broadens out over the entire sclerite.

Wings: subhyaline with a faint yellow tinge; brown clouds at end of R_1, R_2, around cross vein *r*, at fork of R_{2+3}, at origin of R_{4+5}, along remainder of the cord, along cross vein *m* and the deflection of M_3. Venation: Sc long, approximating R_1 at the tip as in the genus; *r* nearer to tip of R_1 than to the fork of R_{2+3}; Rs long, strongly arcuated at its origin, then running parallel to R_1; R_{2+3} in a line with Rs and R_3; R_2 strongly curved cephalad at its tip; R_3 strongly curved caudad at its tip, so that cell R_2 is very broad on its distal portion; deflected portion of R_{4+5} very long, so that cell R_5 is much nearer the base of the wing than cells R_5 or first M_2. M in a direct line with M_3; M_{1+2} fused for a long distance beyond *m*. Basal deflection of Cu_1 slightly anterior to the fork of M. (See fig. 39.)

Habitat.—Holotype.—Corumba, Matto Grosso, Brazil, April (H. H. Smith, coll.).

Type.—In American Museum of Natural History.

LECTERIA ARMILLARIS Fabricius.

Tipula armillaris FABRICIUS, Syst. Antl., 1805, p. 26.

Limnobia armillaris WIEDEMANN, Dipt. Exot., vol. 1, 1821, p. 13; Auss. zweif. Ins., vol. 1, 1828, p. 25.

Limnobia calopus WALKER, Ins. Saund., vol. 1, 1856; Dipt., p. 439.—HUNTER, Trans. Amer. Ent. Soc., vol. 26, 1900, p. 293.—KERTESZ, Cat. Dipt., vol. 2, 1902, p. 171.

Lecteria armillaris OSTEN SACKEN, Studies, etc., pt. 2, 1887, p. 206.—KERTESZ, Cat. Dipt., vol. 2, 1902, p. 218.

Male.—Length 9.2–17.8 mm.; wing, 10.2–12.8; abdomen 13 mm.; antennæ, 3 mm.; legs, hind, femora, 9.6–12.2 mm.; tibia, 9.3–11.6; tarsus, 6–8.9; middle, femora, 7.8–10.8; tibia, 7.4–10.2; tarsus, 6.4–9.4; fore, femora, 7.2–9.8; tibia, 8–10.4; tarsus, 6.9–10.4.

Head: rostrum and palpi dark brown; vertex and occiput dull blackish-gray with numerous long dark brown hairs; front dull gray Antennæ rather short, dark brown, the flagellar segments with scattered long brown hairs and densely covered with shorter appressed hairs; genæ lighter brown.

Thorax: pronotum dark gray-brown; mesonotum, præscutum with an indentation on its margin above the spiracle; light gray with dark velvety blackish stripes, median one broadest near the center of the sclerite, extends back to the suture; on either side of the middle stripe is a lateral one which originates near the cephalic margin of the sclerite, forks at about one-third its length, the inner branch continuing directly back to the suture, the outer branch broadens out on the side of the sclerite, inclosing a rounded yellowish spot at its

Digitized by Google

caudal margin narrowly confluent with the inner branch. The space inclosed by the fork of this stripe, at its cephalic end, is glistening, mirror-like; behind this oval, glistening spot, a small cloud of chestnut-brown; a row of long hairs extending along the lateral branch and its fork, these hairs dark basally, paler brown at their tips; scutum dull blackish-gray; from both forks of the lateral præscutal stripes extends backward a narrow, velvety-black stripe, which meet in a triangle at the outer margin of the sclerite. Caudo-lateral margin of the sclerite produced into a blunt protuberance; scutellum and postnotum light gray, brown on the lateral margin above the base of the halteres. Pleuræ dull bluish-gray with indistinct black marks on some of the epipleural and sternal sclerites. Halteres light yellowish-brown, knob brown. Fore legs, coxæ yellow with a slight gray bloom on its external face; trochanter yellow; femur narrow at the base, soon thickened, clavate, its distal half with long outspread hairs; basal half of the femur pale whitish-yellow with light yellow hairs; a post-median brown ring with black hairs; a broad, bright yellow, sub-apical ring, and an apical ring with black hairs; tibia about uniform in diameter throughout its length, densely clothed with long prominent hairs, a broad basal ring dark brown with black hairs; a narrower, white, sub-basal ring with white hairs; a very broad, brown, median portion with black hairs; a broad white sub-apical ring with white hairs; a narrow apical ring with black hairs; tarsi with prominent hairs, first segment brown with brown hairs except at the tip, which is white with white hairs; segments two and most of three, white with white hairs; tip of three, and four and five, brown. Lower aspect of extreme tip of segment one, and extreme base of segment two, jet black, denticulate. Middle legs similar to fore, but post-median brown band on femur smaller and yellow sub-apical ring broader. Hind legs similar to fore, but the hairs even more conspicuous and showy; claws long, extended, smooth, or with mere indentations on the inner margin.

Wings: hyaline with brown veins; pale brown markings on the wing as follows: a large blotch at the origin of Rs, continuing across cell R; a large row of markings at the tip of R_1 and along the cord; along the second deflection of M_3 and cross-vein *m*; at tip of R_{2+}, apex of the wing, and a faint mark extending from the tip of second anal across cells second A and Cu. Venation (see fig. 42): Sc very long as in the genus; Sc_1 separated from R_1 at the tip by a space equal to the cross-vein *r–m*. Rs strongly arcuated at its origin, almost parallel with R_1, in a direct line with R_2; R_2 leaves R_3 shortly after the fork of Rs and is very strongly curved toward costa at its tip; R_{4+5} strongly arcuated on its deflection; basal deflection of M_{1+2} about four times as long as the basal deflection of M_3; M_3+Cu_1 longer than the basal deflection of Cu_1; Cu_2 equal to the basal deflection of Cu_1.

Digitized by Google

Abdomen: tergum dark brown; apices of the segments yellowish; sternites dull yellow; hypopygium yellow.

Male, San Carlos, Costa Rica (coll. Schilde and Burgdorf). Male, Igarape-assú, Pará, Brazil (alcoholic, Jan. 30, 1912) (Parish, coll.). Female, same place and collector as last (pinned, Jan. 29, 1912).

Genus MONGOMA Westwood.

Mongoma WESTWOOD, Trans. Ent. Soc. Lond., 1881, p. 364.
Trentepohlia BIGOT, Ann. Soc. Ent. France, 1854, p. 474.
Paramongoma BRUNETTI, Rec. Ind. Mus., vol. 6, 1911, p. 295.
Mongomioides BRUNETTI, Rec. Ind. Mus., vol. 6, 1911, p. 296.
Mongomella ENDERLEIN, Zoöl. Jahrbuch, vol. 32, 1912, p. 61.

The genus *Mongoma* was erected by Westwood in 1881 with the African *fragillima* as type. No mention is made, in this paper, of the *Limnobia trentepohlii* Wiedemann which Bigot, in 1854, had made the type of his new genus *Trentepohlia*. Osten Sacken[1] uses the genus *Mongoma* but mentions that it is congeneric with *Trentepohlia*. Skuse[2] and Bergroth[3] use the name *Trentepohlia*. Edwards[4] uses *Trentepohlia* and writes that, as Bigot definitely mentioned *trentepohlii* as type, the name can not be rejected. Brunetti[5] splits the old genus *Mongoma* into three, proposing *Paramongoma* for the *albitarsis* group of the genus, and *Mongomioides* for *trentepohlii* and its allies. Brunetti's statement that *australasiæ* is a strict "*Mongoma*" (p. 291) and, a little later, that "The only Oriental species definitely referable to *Paramongoma* is *albitarsis* Doleschall, but *australasiæ* Skuse is certainly congeneric" (p. 296) is confusing.

Still more recently Enderlein[6] has retained *Trentepohlia* for *trentepohlii* and its allies, as was suggested by Edwards,[7] *Mongoma* for *fragillima* and its allies, and has proposed the new name *Mongomella* for the *albitarsis* group, with *pallida* Williston as type. The name is, of course, strictly synonomous with *Paramongoma* Brunetti.

I have recently shown[8] that the species of the genus show a very gradual transition from one to another, and no division, not even subgeneric, can be accepted. For instance, the new species, *M. disjuncta* would represent another new group because of its two median branches that reach the wing margin, the *Paramongoma* group having but a single median vein. There is but one valid genus, with but a single subgenus, included in the *Mongoma* group, and its species have an equatorial distribution (tropicopolitan).

[1] Studies on Tipulidæ, pt. 2, Berl. Ent. Zeitschr., vol. 31, p. 204.
[2] Dipt. Australia, p. 347.
[3] Ent. Tidskr., vol. 9, p. 135.
[4] Ann. and Mag. Nat. Hist., ser. 8, vol. 8, 1911, p. 63.
[5] Rec. Ind. Mus., vol. 6, p. 291.
[6] Zoöl. Jahrbuch, 1912, pp. 60-62.
[7] Idem, p. 63.
[8] Can. Ent., 1912, p. 88.

Digitized by Google

KEY TO THE SPECIES OF MONGOMA.

1. Veins Cu_1 and M_3 distinct at the wing margin.....*disjuncta*, new species (Brazil).
   Veins Cu_1 and M_3 not distinct at the wing margin.....2.
2. Tarsi of all the legs white.....*niveitarsis*, new species (Greater Antilles).
   Tarsi of all the legs not white.....3.
3. Cell R_2 of the wings very long, much longer than cell R_3.....4.
   Cell R_2 of the wings short, about as long as cell R_3.....5.
4. Larger species; length 7–8 mm.....*manca* Williston[1] (Lesser Antilles).
   Small species; length 5 mm.....*extensa*, new species (Brazil).
5. No stigmal spot; ground color of the body yellow. *pallida* Williston[2] (Lesser Antilles).
   Stigmal spot distinct; ground color of the body brown.
   longifusa, new species (Panama).

MONGOMA DISJUNCTA, new species.

Antennæ brown; body and legs light brownish-yellow; veins M_3 and Cu_1 distinct at the wing margin.

Female.—Length, 11.6 mm.; wing, 10.2 mm; fore leg, femur 11.8 mm.; tibia 14; tarsus 12.6; hind leg, femur 12.4 mm; tibia 12.4; tarsus 9.6. Head: rostrum and palpi brown, the terminal segment s rather darker; antennæ brown; front, vertex, occiput and genæ brownish-yellow.

Thorax: prothorax light brownish, its pleura darker brown. Mesonotum: praescutum dull yellow with a faint brownish tinge; scutum, scutellum, and post-notum brownish-yellow. Pleuræ uniform dull yellow, with no decided contrasts in coloration. Halteres brownish-yellow, the knob, basally, slightly darker. Legs: coxæ, trochanters, femora, and tibiæ dull yellow, tarsi rather lighter yellow.

Wing: dull yellowish-hyaline, darkest at the tip; stigma oval, brown; veins brown, C and Sc more yellowish. Venation: Sc very long, as in the genus; Sc_2 retracted rather far backward, so that Sc_1 is rather longer than R_2. R long, cross vein *r* just before its tip, oblique. Rs rather long, gently arcuated, about equal to R_{2+3}, R_2 short, rather sinuated. R_{4+5} fused with M_{1+2}, obliterating the cross vein *r–m*, this fusion continuing for a short distance beyond the cross vein *m*, when the veins separate in a symmetrical fork. M in a line with M_3 and Cu_1; basal deflection of M_{1+2} very long, longer than R_2. Cu_1 about equal to Cu_2; Cu_1 fuses with M just before the fork of M; at the lower distal angle of cell first M_2 the veins separate, Cu_1 continuing in a straight line with Cu_1+M_3, M_3 arcuates cephalad to the cross vein *m* and continues thence straight to the wing margin. Cu_2 strongly divergent from Cu_1, forming an angle of about 75°. Cu_2 and first A free at the tip; second anal rather long. (See fig. 22.)

Abdomen: tergum dark brown; sternum, segments 1–6 dull yellow, 7–8 dark brown; genital segment dull yellow; valves of the ovipositor not very elongate, dark brown, extreme tips paler, yellowish.

[1] Williston, Trans. Ent. Soc. Lond., 1896, p. 293.
[2] Idem, p. 293, pl. 101, fig. 67.

Digitized by Google

Habitat.—*Holotype.*—Female, Esperito Santo, Brazil. Received from Staudinger and Bang-Haas.

Type.—In author's collection.

MONGOMA NIVEITARSIS, new species.

Dark brown; all tarsi white; wings hyaline.

Female.—Length, 6.8–7 mm.; wing, 6.1–6.3 mm.; hind leg, femur 9 mm.; tibia and tarsus together, 15 mm.

Head: rostrum and palpi dark brown; antennæ moderately elongated, dark brown. Front, vertex, and occiput dark brown.

Thorax: pronotum largely concealed from above by the forward projecting mesonotum, viewed from the side, the prothoracic scutellum is high, bearing six prominent bristles on its margin; separated from the scutum by a deep notch; pronotum dark brown. Mesonotum very gibbous, very dark brown; scutum, scutellum, and postnotum dark brown; pleuræ yellowish brown. Halteres long, slender, brown, the stem palest. Legs: coxæ and trochanters dull yellowish-brown; femora dark olive-brown; tibia brown, extreme base pale; tarsus, segments one and two brownish-white; three to five white, except the claws, which are brown.

Wings: hyaline, slightly darker toward the tip; stigma brown; veins brown. Venation, (See fig. 13.)

Abdomen: tergum dark brown; sternum yellowish-brown; ovipositor, valves very long, slender, dark-brown basally, remainder lighter brown.

The paratype has the tip of the tibiæ and all of the tarsal segments white.

Habitat.—*Holotype.*—Female, El Yunque, Porto Rico, West Indies; 2,850 feet; Feb. 25, 1900 (Coll. C. W. Richmond). *Paratype.*—Female, with the type, Feb. 27, 1900.

Type.—In U. S. National Museum collection (No. 14920).

MONGOMA EXTENSA, new species.

Brown; small, cross vein *r* slightly before the fork of R_{2+3}.

Female.—Length, 5.1 mm.; wing, 4.9 mm. Head: rostrum pale; antennæ and palpi brown; front and vertex brown; occiput and cervical sclerites rather paler brown.

Thorax: dorsum brownish-yellow, the mesothoracic scutum pale yellow in the middle and on the sides. Halteres pale, whitish, knob rather brown. Legs brown, the feet rather lighter-colored, dull yellow.

Wings: subhyaline, a triangular, pale brown, stigmal spot. Venation: R_{2+3} in a line with R_2, which is shorter than it; R_{4+5} leaving R_2 at an angle of about 60°, very long. Fork of R_{2+3} opposite the tip of R_1. Cross vein *r* very indistinct, slightly before the fork of R_{2+3}. Cu_2 rather close to first anal at its tip, the distance separating them at the wing margin only as long as Sc_2. (See fig. 11.)

Abdomen brown.

Digitized by Google

Habitat.—*Holotype.*—Female, Culebra, Panama.

Type.—In U. S. National Museum collection (No. 14921).

Related to *M. manca* Williston, but much smaller and colorational and venational details different.

MONGOMA LONGIFUSA, new species.

Brown; stigmal spot distinct; R_{2+3} longer than R_2 alone.

Length 4.4 mm; wing 4.2 mm.

Female.—Head: antennæ and palpi brown; front, vertex, occiput and cervical sclerites brown.

Thorax: Dorsum brownish-yellow; an indistinct, very narrow, brown median line; transverse suture interrupted medially and præscutum produced caudad into two obtuse denticulæ; pleuræ dull yellow. Halteres light yellowish-brown. Legs uniform brown.

Wings: subhyaline; cells C and Sc slightly more yellow, stigmal spot and extreme tip of the wing pale brown; veins light brown. Venation: Sc_2 retracted rather far toward the base of the wing; R_{2+3} between *r* and the fork, longer than R_2 alone. Basal deflection of Cu_1 before the fork of M. (See fig. 10.)

Abdomen: light brown; lateral line black; the apical segments of the abdomen slender, tubular, valves of the ovipositor very slender, arcuated.

Habitat.—*Holotype.*—Female, Igarape Assú, Pará, Brazil, Jan. 19, 1912 (Parish, coll.).

Type.—In Cornell University collection.

Related to *M. pallida* Williston, but differs as follows: darker in coloration; a distinct, though pale, oval stigma; longer fusion of R_{2+3}, etc.

Genus LACHNOCERA Philippi.

Lachnocera PHILIPPI, Verh. Zoöl.-bot. Ges. Wien, vol. 19, 1865, p. 615.—OSTEN SACKEN, Monographs, vol. 4, 1869, p. 335.

The following description is adapted from Osten Sacken:[1]

Antennæ, at least those of the male, are as long as the body, 13 segmented (?); first segment cylindrical, stout, elongated; the second of the same length as the first, gradually attenuated; the following ones slender, stouter in the middle, on both sides with long, hirsute hairs; the last segments are rather indistinct. Rostrum short; fourth segment of the palpi equal to the third in length (?). Wings with two marginal cells; the first large; the second short, separated from the first by an oblique vein; a single submarginal cell; four posterior cells; discal cell pentagonal; basal cells elongated, the second longer. Feet slender.

LACHNOCERA DELICATULA Philippi.[2]

The following is translated from Philippi's original description:

First segment of the antennæ testaceous; remainder and palpi, grayish-brown; thorax testaceous with brown stripes; coxæ and

[1] Translation, Monographs, vol. 4, 1869, p. 335.

[2] Verh. Zool-bot. Ges. Wien, vol. 19, 1865, pl. 23, fig. 5.

Digitized by Google

trochanters pale; abdomen and remainder of the feet, greyish-brown; wings little infuscated; stigma dusky.

Male.—Length, body, 2½ lines; wing expanse, 6½ lines.

Habitat.—Valdivia, Chile.

Genus GONOMYIA Meigen.

Gonomyia MEIGEN, Syst. Beschr., vol. 1, 1818, p. 146.—OSTEN SACKEN, Studies, pt. 2, 1887, p. 200.
Taphrosia RONDANI, Prodr, vol. 1, 1856, p. 1820.
Goniomyia OSTEN SACKEN, Monographs, vol. 4, 1869, p. 177.

Gonomyiæ appear to be numerous in the Neotropical regions and many species are herein recorded. Some of the aberrant species that I have referred to the subgenus *Leiponeura* Skuse, have been placed in various genera of the Antochini, simply because of the lack of one branch of the radial sector. Thus *Atarba puella* Williston, *A. pleuralis* Williston, *Elliptera*, sp. (Williston); *Elliptera alexanderi* Johnson, and the two Australian species of *Leiponeura* are, apparently, all Gonomyiæ. I have had for examination all of the American Gonomyiæ excepting *G. galactoptera* Bergroth, of Alaska. (Aldrich gives also *G. caudata* Lundberg, but Kertesz calls this an *Empeda*.)

The American species referable to the subgenus *Gonomyia* Meigen, (type *tenella* Meigen) are *blanda* Osten Sacken; *cognatella* Osten Sacken; *subcinerea* Osten Sacken; *sulphurella* Osten Sacken; *virgata* Doane; *galactoptera* Bergroth; *delicata*, new species; and *unicolor*, new species.

Those species referable to *Leiponeura* Skuse (type *gracilis* Skuse) are *manca* Osten Sacken; *pleuralis* Williston; *puella* Williston; *alexanderi* Johnson; and *puer*, new species.

In the genus *Gonomyia* the prominent foveæ on the sides of the mesothoracic præscutum that I have called the "pseudosuture" are normal in position, but the tuberculate pits are far cephalad and small, located on the anterior margin of the sclerite.

KEY TO THE SUBGENERA OF GONOMYIA.

1. Radial sector with 3 branches reaching the wing margin.....*Gonomyia* Meigen.
   Radial sector with but 2 branches reaching the wing margin...*Leiponeura* Skuse.

KEY TO THE SPECIES OF LEIPONEURA SKUSE.

1. Femora with a distinct brown band before the tip.....2.
   Femora unicolorous, not banded at the tip.....3.
2. Hind legs with the tibia china-white; tibiæ tipped with dark brown, *alexanderi* Johnson[1] (Eastern U. S.).
   Legs uniform, brownish-yellow.....*manca* Osten Sacken[2] (Eastern U. S.).

[1] Psyche, Feb., 1912, p. 3, fig. 6.
[2] Monographs, vol. 4, pp. 178, 179 (male, footnote).

Digitized by Google

KEY TO THE SPECIES OF LEIPONEURA SKUSE—continued.

3. Pleural stripes dark chestnut-brown and yellow, distinct; stigma clear cut, dark-brown.....*pleuralis* Williston (Cuba—St. Vincent Is.).
Pleural stripes indistinct, or faintly indicated; stigma faint or lacking..... 4.
4. A faint blue tinge on pleuræ; no stripes; mesonotum light brown, *puella* Williston (Lesser Antilles; Mexico).
Pleuræ plumbeous with a yellow stripe; mesonotum brownish-gray, *puer*, new species (Greater Antilles).

KEY TO THE SPECIES OF GONOMYIA MEIGEN.

(Neotropical and Nearctic, excluding boreal forms.)

1. Wings spotted.....*blanda* Osten Sacken [1] (E. and SE. United States).
Wings unmarked (except stigmal spot in cases).....2.
2. Femora with a distinct brown anteapical band, *sulphurella* Osten Sacken [2] (E. United States).
Femora unicolorous, unbanded.....3.
3. Antennæ orange or yellow at the basis.....4.
Antennæ entirely brown or black.....5.
4. Pleural stripes dark brown; Sc very short.....*delicata*, new species (Guatemala).
Pleural stripes reddish; Sc longer, ending slightly before the origin of Rs., *cognatella* Osten Sacken [3] (E. United States).
5. Pleuræ with a brown stripe running from collare to base of halteres, *virgata* Doane [4] (W. United States).
Pleuræ without distinct stripes.....6.
6. Pleuræ uniformly light yellow; basal deflection of Cu_1 at the inner end of the short cell first M_2.....*subcinerea* Osten Sacken [5] (E. United States).
Pleuræ rich light brown; basal deflection of Cu_1, under the middle of the long cell first M_2.....*unicolor*, new species (Mexico and C. America).

GONOMYIA (LEIPONEURA) PLEURALIS Williston.

Atarba pleuralis WILLISTON, Trans. Ent. Soc. Lond., 1896, p. 289, pl. 10, fig. 61, male and female.—COQUILLETT, Proc. U. S. Nat. Mus., 1900, p. 250.—KERTESZ, Cat. Dipterorum, vol. 2, 1902, p. 189.—ALDRICH, Cat. N. Amer. Dipt., 1905, p. 82.—WILLISTON, Man. N. Amer. Dipt., 1908, p. 85 (fig. 32).
Atabarba pleuralis HUNTER, Trans. Amer. Ent. Soc., 1900, p. 290.
Gonomyia pleuralis ALEXANDER, Ent. News, vol. 23, 1912, p. 419.

Male.—Length, 5.1 mm; wing, 3.4 mm.

Female.—Length, 6.4 mm; wing, 5 mm.

Head: rostrum and palpi dark brown; antennæ, basal two or three segments light yellow, remainder brown; front, vertex and occiput light yellow; a black spot on the vertex between the eyes.

Thorax: mesothoracic præscutum rich chestnut-brown, lateral and cephalic margin broadly light yellow, this bordered internally by a narrow line of darker brown; pseudosuture light brown, short, triangular; scutum like the præscutum; scutellum yellow with a narrow

[1] Monographs, vol. 4, pp. 182, 183, male and female.
[2] Idem, pp. 180, 181, male and female.
[3] Idem., p. 181, male and female.
[4] Journ. N. Y. Ent. Soc., 1900, p. 189, pl. 7, fig. 21.
[5] Monographs, vol. 4, pp. 181, 182, male and female.

Digitized by Google

brown median line; post-notum light yellow with a transverse semilunar mark on the cephalic margin of the sclerite. Pleuræ light yellow; a broad chestnut band extending along the dorsal edge of the epipleuræ, becoming indistinct beyond the wing-basis. Two dark brown bands, one just under the chestnut epipleural band, the other near the venter traversing the coxæ, these inclosing between them a rather broad light yellow stripe; sternum light yellow. Halteres light brownish-yellow. Legs light yellow; femora and tibiæ indistinctly darker at their tips.

Wings hyaline; stigma distinct, oval, dark brown.

Abdomen: caudal margin of tergites brownish-black, remainder of the tergites dull yellow; sternites light brown, darker on the pleural region, especially the first two abdominal segments where they are blackish-brown, formed by the conjunction of the brown thoracic pleural stripes.

Distribution.—Aguadilla, Porto Rico; Jan., 1899, female (Aug. Busck, coll.), (see Coquillett). Baracoa, Cuba; Sept., 1901 male (Aug. Busck, coll.). St. Vincent, West Indies (H. H. Smith, coll.), Williston, male and female.

GONOMYIA (LEIPONEURA) PUELLA Williston.

Atarba puella WILLISTON, Trans. Ent. Soc. Lond., 1896, pp. 288, 289, pl. 10, fig. 60, male and female.—KERTESZ, Catalogus Dipterorum, vol. 2, 1902, p. 189.—ALDRICH, Cat. N. Amer. Dipt., 1905, p. 82.—ENDERLEIN, Zool. Jahrbuch, 1905.

Atabarba puella HUNTER, Trans. Amer. Ent. Soc., vol. 26, 1900, p. 290.

Female.—Length, 3.4–4 mm; wing, 3.8 mm. Head: rostrum light yellow; antennæ, first two segments brownish-yellow, flagellum brown; front and center of the vertex light yellow; sides of vertex and occiput grayish.

Thorax: mesonotum, præscutum light brown with a faint dark brown bloom; pseudosuture deep, short, triangular, reddish; lateral margin of the præscutum pale yellowish-white; scutum, scutellum and post-notum light brown; caudal margin of the scutellum brownish-yellow. Pleuræ light brown with a distinct pinkish-white tinge overspreading the sclerites; sternum dull brownish-yellow. Halteres light colored, knob slightly darker. Legs yellowish-brown throughout. Wings hyaline.

Abdomen: uniformly brown, the sternum and genital segment lighter, yellowish.

Redescribed from two females from San Rafael, Vera Cruz, Mexico (Townsend, coll.), and two of Williston's female paratypes, from St. Vincent, 1,000 feet.

Distribution.—Vera Cruz, Mexico; St. Vincent, Lesser Antilles.

Digitized by Google

GONOMYIA (LIPONEURA) PUER, new species.

Brownish-gray; scutellum pale on caudal margin; pleuræ plumbeous, striped with yellow; wings hyaline.

Female.—Length, 4 5–5 mm; wing, 4–4.5 mm. Head: rostrum brownish-yellow; palpi dark brown; antennæ light brown; front whitish, flesh color, semituberculate; vertex and occiput bluish-gray pruinose; genæ brighter blue-gray.

Thorax: mesonotum, præscutum brownish-gray except the extreme lateral margin which is light yellow, broadest anteriorly; pseudosuture elongate-triangular, reddish-brown; scutum brownish-gray, paler medially and on the externo-caudal angles; scutellum yellow; post-notum brownish-gray, thickly blue pruinose. Pleuræ plumbeous with a yellow stripe beginning above the fore coxa, continuing caudad to below the halteres, brightest anteriorly; sternum yellowish. Halteres pale, knob slightly darker. Legs: coxæ and trochanters yellow; femora, tibiæ and tarsi yellowish-brown, uniform.

Wings: hyaline, stigma very faintly indicated. (See fig. 14.)

Abdomen: dorsum dark brown; genital segment dull reddish-yellow.

Type.—In U. S. National Museum collection (No. 14932).

Paratypes.—Females: mesonotum grayish-brown, the cephalic and lateral margins of the præscutum pale, cream-color; pale pleural stripes broader; lateral margins of the abdominal tergites pale on their basal half, giving a semiannulated appearance.

Habitat.—Holotype.—Female, Santo Domingo, West Indies (Aug., 1905), (Busck, coll.).

Paratypes.—Females, with the type (San Francisco Mountains; Sept., 1905).

GONOMYIA (GONOMYIA) DELICATA, new species.

Antennæ with two basal segments light yellow; head light yellow with a dark line on vertex; mesonotum brown; pleuræ yellow with distinct brown stripes; legs unicolorous, yellowish-brown; wings hyaline; stigma pale brown.

Female.—Length, 4.6 mm.; wing, 6 mm. Head: rostrum and palpi dark brownish-black; antennæ, two basal segments light yellow, remainder dark brownish-black; front and occiput light yellow; vertex light yellow with a linear dark brown medial stripe; genæ faintly tinged with darker.

Thorax: pronotum light yellow with a broad median grayish-brown stripe; mesonotum brown; pseudosuture elongate, triangular, deep, shiny reddish; a pale line from the mesal end of this fovea continuing back to the transverse suture. Lateral margin of the præscutum bright light yellow, broadest behind. Scutum brown, indistinctly paler medially; scutellum light brown; post-notum

Digitized by Google

light yellow, browner in front. Pleuræ light yellow with two narrow dark brown stripes, the upper continuing from the side of the pronotum, obliquely caudad to the base of the halteres; the lower short, beginning under the precoxa, running backward to the mesocoxa. Halteres, brownish-white. Legs: coxæ and trochanters light yellow; femora, tibæ and tarsi yellowish-brown, uniform.

Wings: hyaline, stigma pale brown.

Abdomen: tergum dark brown, uniform; sternum uniform light yellow.

Habitat.—Holotype.—Female—Totonicipan, Guatemala, Central America (1902), (G. Eisen).

Type.—In U. S. National Museum collection (No. 14933).

Near *G. cognatella* Osten Sacken; differing in coloration, pleural stripes more distinct, etc.; venation (Sc very short, etc.). *Delicata* has Rs rather long, arcuated at its origin with a slight spur; the distance on R from tip of Sc to origin of Rs almost as long as Rs itself.

GONOMYIA (GONOMYIA) UNICOLOR, new species.

Head dark gray; antennæ blackish-brown; mesonotum brown; pleuræ light brown, not striped; legs uniform yellowish-brown; wings hyaline.

Male.—Length, 3.9 mm.; wing, 4.6 mm.

Female.—Length, 4.8 mm.; wing, 5 mm.

Head: rostrum and palpi brown; antennæ uniformly dark blackish-brown throughout; front, vertex and occiput uniform blackish-gray.

Thorax: mesonotum, præscutum medium brown; pseudosuture prominent, dark brown; scutum similar to the præscutum; scutellum pale, yellowish; post-notum medium brown. Pleuræ rich light brown, the sternum rather darker. Halteres brown, paler at the extreme base. Legs: coxæ, trochanters, femora, tibiæ and tarsi, yellowish-brown, unicolorous.

Wings: hyaline. (See fig. 15.)

Abdomen: tergum medium brown throughout; hypopygium slightly paler; sternum paler, yellowish.

Habitat.—Holotype.—Female, Aguna, Guatemala, Central America (2,000 feet), (G. Eisen). *Allotype.*—Male, with the type. *Paratype.*—Male and female, with the type.

Type.—In U. S. National Museum collection (No. 14934).

Three specimens, two from Totonicopan, Guatemala, July, 1902, female and male (G. Eisen), and one from Córdoba, Mexico (May 8, 1908) (F. Knab), are larger, mesonotum more greyish, pseudosuture and tuberculate pits black, conspicuous and venation slightly different. I believe them to be variations of the species. Length, male 6.1 mm.; female, 7 mm. I have labeled them *unicolor*, var.

Digitized by Google

Genus SACANDAGA Alexander.

Sacandaga ALEXANDER, Ent. News, 1910, pp. 349–352, figs. 1–3; Idem, 1911, pp. 71–73.

KEY TO THE SPECIES OF SACANDAGA.

1. Length, 5 mm.; wing, 6–7 mm.; color of the body, yellowish; wings, hyaline. *flava* Alexander [1] (Eastern U. S.).
Length, 2.9–4.5 mm.; wing, 4–5 mm.; color of the body, brown; wings, gray. *parva*, new species (Greater Antilles).

SACANDAGA PARVA, new species.

Antennæ brown; color of body brown; wings gray.

Male.—Length, 2.9 mm.; wing, 4 mm. Head: rostrum and palpi dark brown; antennæ dark brown, the first flagellar segment elongated. Eyes widely separated by the very broad front and vertex; front, vertex, and occiput dark blackish-brown with an indistinct sparse gray bloom.

Thorax: pronotum barely visible from above, dark brown, the sides of the scutellum more yellowish; mesonotum, præscutum rather dark brown; space in front of the pseudosuture more yellowish; pseudo-sutural fovea deep, shiny, dark brownish-black, elongate semilunar; tuberculate pits dark brown, far cephalad, nearer the anterior margin of the sclerite than to the pseudo-suture, separated from one another by a distance equal to about one and one-half the diameter of either; scutum, scutellum, and post-notum dark brown, pleuræ grayish-brown, region about the wing basis yellowish. Halteres yellow at basis, stem and knob brownish; stem with long brown hairs. Legs: coxæ and trochanters dull yellow; femora, tibia, and tarsi dark brown.

Wings: gray throughout, costal cell more brownish; veins brown. Venation (see fig. 9): Sc quite long, its distance beyond the origin of Rs about two and one-half times the length of cross vein *r–m*. Sc_2 rather indistinct, far removed from the tip of Sc_1. R rather long, however, the tips of R_1 and R_2 are much more widely separated than in *S. flava*. Rs long, gently arcuated; R_{2+3} much longer than cell R_2; R_3 is missing in its distal portion (an abnormity rather than a specific character); R_2 short, almost perpendicular; cross vein *r–m* and the basal deflection of R_{4+5} subequal. Basal deflection of M_{1+2} practically gone, M being almost in a line with M_{1+2}; second anal long bisinuated. Cell first M_2 not so regularly hexagonal as in *flava*, anal angle very prominent.

Abdomen: tergum dark brown, sternum brownish-yellow on basal five segments.

Female.—Length, 4.6 mm.; wing, 5 mm. Similar but larger; abdominal sternum darker, brown; valves of the ovipositor yellowish.

[1] Ent. News, vol. 22, 1910, pp. 349–352, figs. 1–3, male and female.

Digitized by Google

Habitat.—Holotype.—Male, Yallahs Valley, Blue Mountains, Jamaica, Feb. 24, 1911. *Allotype.*—Female, San Francisco Mountains, Santo Domingo, Sept. 27, 1905 (Aug. Busck, coll.).

Holotype.—In American Museum of Natural History.

Allotype.—In U. S. National Museum collection. (No. 14,930).

The discovery of this tiny species in the Greater Antilles is interesting. Its only known relative, *S. flava,* was but recently described from the Eastern United States. The present insect is in perfect generic agreement with *flava* in its shortened antennæ, prominent anal angle, sinuosity of second anal, etc.

Genus CRYPTOLABIS Osten Sacken.

Cryptolabis OSTEN SACKEN, Proc. Acad. Nat. Sci. Phila., 1859, p. 224; Monographs, vol. 4, 1869, p. 185; Studies, etc., pt. 2, 1887, p. 205.

KEY TO THE SPECIES OF CRYPTOLABIS.

1. Rs short, so that the cell first R_1 forms a rough equilateral triangle; Rs shorter than the free portion of M_3 beyond the deflection of Cu_1.....2.
   Rs long, so that the cell first R_1 forms a triangle that is not equilateral; Rs longer than the free portion of M_3 beyond the deflection of Cu_1
   tropicalis, new species (Central America).
2. Thorax wholly grayish-brown; head dark brown; antennæ brown
   bisinuata Doane[1] (West. U. S.).
   Thorax pale buff with three black stripes, the middle one double; head blackish; antennæ black.....*paradoxa* Osten Sacken[2] (East. U. S.).

CRYPTOLABIS TROPICALIS, new species.

Pale, yellowish-brown; radial sector elongate.

Male.—Length, 3–3.8 mm.; wing, 4.4 mm. Head: rostrum and palpi brown; basal segment of the antennæ brown, remainder of the antennæ dark brown; eyes elongate-ovate, rather approximated; front brown; vertex narrow between the eyes; vertex and occiput light yellow.

Thorax: pronotum light yellow; mesonotum: præscutum light yellowish-brown with an olive tinge; scutum, scutellum, and postnotum yellowish-brown. Pleuræ pale whitish-yellow with a light brown line extending from the prosternum obliquely to the base of the halteres. Halteres light yellowish. Legs: coxæ, trochanters, femora, tibiæ, light brownish-yellow, the hind femora lightest yellow; tip of the tibia darker; tarsi light yellowish; segments 4 and 5 darker, brown. Wings hyaline, veins brown, except C, Sc, and R, which are yellow. (See fig. 8.)

Abdomen: tergum brown; genital segment light yellow; sternum light yellow.

A paratype differs in having the rostrum, palpi and front more yellowish; thoracic dorsum more distinctly tinged with brown; the second paratype has a more reddish tinge to the præscutum.

[1] Journ. N. Y. Ent. Soc., vol. 8, pp. 189, 190, pl. 7, fig. 22, male.
[2] Monographs, vol. 4, p. 186, pl. 2, fig. 11, male and female.

Digitized by Google

Habitat.—*Holotype.*—Male, Trece Aguas, Cacao, Alta Vera Paz, Guatemala, April 23, 1906 (Barber and Schwarz, coll.). *Paratypes.*—Two, same locality and collector; April 27.

Type.—In U. S. National Museum collection (No. 14929).

Genus MOLOPHILUS Curtis.

Molophilus CURTIS, British Entomology, 1833, p. 444.—OSTEN SACKEN, Monographs, vol. 4, 1869, p. 162.

KEY TO THE NEOTROPICAL SPECIES OF MOLOPHILUS.

1. Color black; fore and hind tibiæ with long fringes of hairs.
thaumastopodus, new species (Brazil).
Color light grayish-brown; tibiæ without conspicuous fringes of hairs.
guatemalensis, new species (Central America).

MOLOPHILUS THAUMASTOPODUS, new species.

Dull greyish-black; fore and hind tibiæ with long fringes of hair; wings and halteres dark.

Female.—Length, 4.2 mm; wing, 4.1 mm.; fore leg, femur, 3 mm; tibia and tarsus, 5 mm.; middle leg, femur, 2.6 mm; tibia and tarsus, 3.7 mm.; hind leg, femur, 4.6 mm; tibia and tarsus, 6 mm.; head: rostrum and palpi brownish-black; antennæ dark brown, each segment somewhat paler at the base; antennæ rather long, the segments oval, with long blackish hairs. Front, vertex and occiput dull grayish-black.

Thorax: dorsum dull grayish-black throughout; pseudosuture black. Pleuræ uniform dull blackish. Halteres black, light brown at the base. Foreleg: coxæ and trochanters yellowish-brown; femur brown, paler on the basal half, slender basally, stout apically, with long dark brown hairs appressed internally, subappressed externally, tibia slender, dark, blackish, with a patch of white hairs near the base on the outer side; a long fringe of black hairs on the same side, four or five times as long as the diameter of the tibia; tarsus black, segment 1 with the basal half white on the external side; tarsus clothed with long appressed hairs. Middle leg: coxa and trochanter dull yellowish-brown; femora rather uniform dark brown, with long appressed hairs; tibia dark brownish-black, a small white spot on the side near the base; tarsi dark brownish-black, a few white hairs at the base of segment 1. Hind leg: coxa and trochanter dull yellowish-brown; femora paler basally, dark brownish-black on the apical half, very slender at origin, but stout at the tip, at the extreme tip, on the outer side, a patch of white hairs; tibia slender, dark brownish-black, hairs long, appressed on basal third; on apical two-thirds, the hairs stand out straight on four sides, being from seven to eight times as long as the diameter of the tibia; tarsus, segment 1 black, with long black hairs on the outer face, appressed internally; segments two to five with long white hairs externally, short black ones internally.

Digitized by Google

Wings blackish-gray; veins with long black hairs; venation (see fig. 12); wings metallic in lights.

Abdomen: tergum black except the genital segment, which is dark brown; tips of the ovipositor yellow; sternum dark brown.

Habitat.—Holotype.—Female, Pará, Brazil (No. 6316 on slip) (C. F. Baker, coll.).

Paratype.—Female, Igarape Assú, Pará, Brazil, Jan. 21, 1912. (H. S. Parish, coll.).

Holotype.—In U. S. National Museum collection. (No. 14927).

Paratype.—In Cornell University collection.

MOLOPHILUS GUATEMALENSIS, new species.

General color light grayish brown; antennæ rather short, dark brown; legs normal.

Male.—Length, 4.8 mm.; wing, 5 mm. Head: palpi and rostrum dark brownish black; antennæ dark brown, rather short; front, vertex, genæ, and occiput uniformly dull gray; hind margin of the head broadly rounded.

Thorax: light grayish-brown; mesonotum: præscutum with a row of brown hairs on either side of the median line; pseudo-suture elongate-triangular, dark brown, connected with the lateral margin of the sclerite by a narrow depressed line; tuberculate pits jet black, rather far forward, about midway between the pseudo-suture and the cephalic margin of the præscutum, closely approximated, the distance between them less than the diameter of either one. Scutum grayish; scutellum light yellowish-brown; post-notum grayish. Pleuræ grayish-blue, darkest on the mesoepipleuræ. Halteres light yellowish-brown.

Feet: coxæ and trochanters light yellowish-brown; femora light brown, darkest apically; tibiæ yellowish-brown, tip dark brownish-black; tarsi black.

Wings: tinged with brown.

Abdomen: tergum dark brown clothed with long yellowish hairs; genitalia paler, yellow.

Habitat.—Holotype.—Male, Guatemala (probably Guatemala City), Cent. Am.; Sept. 10, 1902 (G. Eisen, coll.).

Type.—In U. S. National Museum collection (No. 14928).

Genus HELOBIA Le Peletier.

Helobia Le Peletier, Encycl. Méth., Ins., vol. 10, 1825, p. 585.
Symplecta Meigen, Syst. Beschr., vol. 6, 1830, p. 282.
Idioneura Philippi, Verh. Zoöl.-bot. Ges. Wien, vol. 15, 1865, p. 615.
Symplectomorpha Mik, Wien. Ent. Zeitung, vol. 5, 1886, p. 318.

In the material from the United States National Museum there were six specimens that I have determined as the almost cosmopolitan species, *H. hybrida* Meigen. It is very probable that *H. macroptera*

Digitized by Google

Philippi[1] will prove to be the same species. The data for this material are:

Totonicipan, Guatemala, Central America, 1902 (G. Eisen, coll.), 3 males, 2 females. Antigua, Guatemala, Central America, 1 female.

Genus ERIOPTERA Meigen.

Erioptera MEIGEN, Illiger's Magazine, vol. 2, 1803, p. 262.
Chemalida RONDANI, Prodromus Dipt. Italicæ, vol. 1, 1856, p. 180.
Limnæa RONDANI, Prodromus Dipt. Italicæ, vol. 1, 1856, p. 181.
Ilisia RONDANI, Prodromus Dipt. Italicæ, vol. 1, 1856, p. 182.
Limnoica RONDANI, Prodromus Dipt. Italicæ, vol. 4, 1861, Corrigenda, p. 11.
Trichosticha SCHINER, Wien. Ent. Monatschr., vol. 7, 1863, p. 221.
Erioptera OSTEN SACKEN, Monographs, vol. 4, 1869, p. 146.

The subgenera of the genus ERIOPTERA Meigen.

Erioptera MEIGEN, Illigers Magazine, vol. 2, 1803, p. 262.
Cheilotrichia ROSSI, Verz. österreich. Dipt., 1848, p. 12.
Acyphona OSTEN SACKEN, Monographs, vol. 4, 1869, p. 151.
Hoplolabis OSTEN SACKEN, Monographs, vol. 4, 1869, p. 152.
Mesocyphona OSTEN SACKEN, Monographs, vol. 4, 1869, p. 152.
Empeda OSTEN SACKEN, Monographs, vol. 4, 1869, p. 183.

Of these subgenera, *Mesocyphona* and *Empeda* are the only ones definitely known to occur in the Neotropical fauna. The great majority of species fall within the *Mesocyphona* group, which, in the tropics, shows quite a diversity of wing and leg patterns. The genus will probably prove to be a very extensive one when more extended collections are made.

In his Catalogue, E. Lynch Arribalzaga gives *Erioptera* (*Mesocyphona*) *hirsutipes* Macquart, described from the Canary Islands, and which Osten Sacken placed in *Trimicra*. There is certainly an error in this determination, and I have omitted the species from the list.

KEY TO THE SPECIES OF MESOCYPHONA.

1. Wings with dark or light spots ..... 2.
   Wings unspotted, hyaline or nearly so ..... 11.
2. Wings light colored with darker, more or less distinct spots ..... 3.
   Wings dark colored, at least on the cells C, Sc, and R, with lighter spots and dots. 4.
3. Femora, tibiæ, and tarsi conspicuously annulated.
   annulipes Williston (Lesser Antilles, Brazil).
   Femora, with one subapical ring; tibiæ and tarsi unicolorous.
   parva Osten Sacken[2] (East. U. S., Brazil).
4. Large species (wing 6 mm. in length) ..... *splendida*, new species (C. Amer.).
   Smaller species (wing 4 mm. or less) ..... 5.
5. Centers of cells M, Cu, and A of the wings almost hyaline, colorless.
   knabi, new species (Mexico).
   Centers of cells M, Cu, and A of the wings, although paler than cells C, Sc, and R, more or less tinged with gray or brown ..... 6.

[1] Verh. Zool-bot. Ges. Wien, vol. 15, 1865, p. 615, pl. 23, fig. 4.
[2] Monographs, vol. 4, p. 162, male and female.

Digitized by Google

KEY TO THE SPECIES OF MESOCYPHONA—continued-

6. Spots on the wings scanty, twenty or less..... *eiseni*, new species (C. Amer.).
   Spots on the wing numerous..... 7.
7. Mesonotum with a dark line on either side of the pale median vitta; tuberculate pits between the dark lines..... 8.
   Mesonotum with three very narrow dark lines; the median one passing between the tuberculate pits..... *costalis*, new species (C. Amer., Cuba).
8. Mesonotum clear gray; pleural stripes clear-cut, distinct.
   distincta Alexander [1] (Southwest. U. S.).
   Mesonotum yellowish; pleural stripes not clear-cut; indistinct..... 9.
9. Spots on the wings not occurring in the cells; femora with a subapical brown band only..... *dulcis* Osten Sacken [2] (West. U. S.).
   Spots on the wings numerous inside the cells; femora with a medial and subapical brown band..... (*caloptera* group) 10.
10. Lighter colored northern form; hind femora with the post-medial yellow band as wide as the subapical dark band,
   caloptera caloptera Osten Sacken [3] (East. U. S.).
   Dark southern form; hind femora with the post-medial yellow band much narrower than the subapical dark band,
   caloptera femoranigra, new subspecies (Cent. Amer.).
11. Femora with a single dark subapical band,
   immaculata, new species (Mexico, Cent. Amer.).
   Femora with two dark bands..... *bicinctipes*, new species (Brazil).

ERIOPTERA (MESOCYPHONA) ANNULIPES Williston.

Erioptera annulipes WILLISTON, Trans. Ent. Soc. Lond., 1896, p. 294, female—HUNTER, Trans. Amer. Ent. Soc., 1900, p. 290.—KERTESZ, Catalogus Dipterorum, vol. 2, 1902, p. 200.—ALDRICH, Cat. N. Amer. Dipt., 1905, p. 84.—ENDERLEIN, Zool. Jahrbuch, 1912, pp. 54, 55, fig. G1, female.

Male.—Head: rostrum and palpi brown; antennæ brown; front, vertex and occiput clear light gray.

Thorax: mesonotal præscutum light brown; dorsal stripes very indistinct, close together; pseudosuture shallow, elongate, pale, tuberculate tips black, close together, the space between them about equal to the diameter of one; scutum and post-notum similar to præscutum; scutellum pallid, yellowish, with two indistinct dorsal lines. Pleuræ light brown, stripes indistinct, the pale white band between the second and third dark stripe, indistinct, narrow; sternum whitish. Halteres white throughout. Hind leg: coxa and trochanter pale yellow; femur long, white, with four blackish-brown rings, subbasal, premedian, post-median, and subapical, the last broadest; tibia white with three rings, subbasal, median, and subapical, the last narrowest; first tarsal segment black at base and tip; segments 3 to 5 all black. Middle leg similar to hind leg, but first femoral band is very small, indistinct, the others gradually wider. Fore leg, similar to hind leg, but only three femoral bands.

[1] Psyche, vol. 19, Dec., 1912, pp. 165, 166.
[2] Western Diptera, Bull. U. S. Geol. Surv., vol. 3, No. 2, pp. 198, 199 (April, 1877).
[3] Monographs, vol. 4, pp. 161, 162, male and female.

Digitized by Google

Wings hyaline, costa and subcosta indistinctly dark above the origin of Rs, at Sc_2, at tip of Sc_1, tip of R_1, and tip of R_2; veins composing the cord darker.

Abdomen: light brown, with a dark median tergal stripe.

Allotype.—Male, Aguna, Guatemala, Central America (G. Eisen).

One male with the allotype; one female taken at Igarape Assú, Pará, Brazil, January 19, 1912 (Parish, coll.).

Ranges from St. Vincent to Brazil.

ERIOPTERA (MESOCYPHONA) PARVA, var. BRASILIENSIS, new subspecies.

Similar to the typical *parva* of the eastern United States, but much darker in coloration. The color of the body is dark brown, not brownish-yellow, especially pronounced on the abdomen which is uniform in pattern (see fig. 27).

Habitat—Fifty-five specimens taken at Igarape Assú, Pará, Brazil, from January 19–February 7, 1912 (Parish, coll.). All of this large series were females.

Holotype.—Cornell University collection.

Paratypes.—In author's collection, American Museum of Natural History, Academy of Natural Sciences, and U. S. National Museum collections.

ERIOPTERA (MESOCYPHONA) SPLENDIDA, new species.

Large species; wing 6 mm. long; vertex variegated; mesonotum pale brownish-gray, bi-vittate dorsally; wing grayish-brown, spotted and dotted with white.

Male.—Length, 4 mm.; wing 6 mm.

Female.—Length, 4.7 mm.; wing, 6.1 mm.

Male.—Head: rostrum and palpi dark brown; antennæ, second segment oval, tumid, two basal segments brown; flagellum, first five segments cream color; remainder darker, brown. Front brown; vertex pale cream color nearest the eyes, in the center dark brownish-black; occiput and extreme median portion of the vertex grayish-yellow; the dorsal aspect of the head appears to have a dark V on a light ground.

Thorax: pronotum broader behind, prolonged cephalad into a long point; scutellum narrow, interrupted medially by a shallow fovea, pale brownish-gray. Mesonotum: præscutum with the tuberculate pits separated from one another by a distance equal to from one to two times the diameter of either tubercle; pseudosuture present as a deep linear hollow extending from the lateral margin of the sclerite, just above the spiracle, toward the median line; this hollow is broadest at either end, constricted or interrupted near its middle. Præscutum pale brownish-gray; lateral margins dark brown, broadest caudad, confluent in front; a longitudinal

Digitized by Google

stripe on either side of the middle line, this stripe narrow in front, broader behind, continuing almost to the suture, not touching the tuberculate pits; on the side of the sclerite, anterior to the pseudosuture, the ground color is brighter, yellowish; scutum similar in ground color, a forked brown stripe on either side which is a prolongation of the median præscutal stripes; scutellum grayish, paler behind; post notum gray with a brown median stripe; tuberculate pits and pseudosuture dark brown. Pleuræ grayish with three oblique brown bands; one (dorsal) passing through the mesothoracic spiracle; the second from the foreleg to the meta-notum; between these two, a yellow line extending from the cervical sclerites caudad; third dark band passes just above the mesocoxa; the second and third stripes delimit a broad, conspicuous, silvery-white area; sternum gray. Halteres light yellow, the knob darker, brownish. Legs: coxa brown; trochanter, paler, yellow; femora yellow with a brown subapical ring; tibia and tarsus light yellow, the apical two tarsal segments darker, brown.

Wings: grayish-brown with numerous white spots and dots abundantly sprinkled in all the cells; the larger spots being (1) in base of cells R and M; (2) at the origin of Rs; (3) at Sc_2 extending from the costa to the sector; (4) at the tip of Sc_1 and (5) along the basal deflection of Cu_1, the veins brown except where the spots encroach upon them where they are yellowish-white. (See fig. 28.[1])

Abdomen: tergum yellowish-brown, with a narrow black median stripe and a broader lateral one; sternum yellowish.

Habitat.—Holotype.—Male, Totonicipan, Guatemala, C. Am.; 1902 (G. Eisen). *Allotypé.*—Female, with the holotype. *Paratype.*—Male, with the holotype.

Type.—In U. S. National Museum collection (No. 14922).

ERIOPTERA (MESOCYPHONA) KNABI, new species.

Vertex grayish-brown, unicolorous; mesonotum dull gray, dorsal stripes very narrow; pleural stripes rather indistinct; apical half of femora dark; costal and sub-costal cells of wing dark with a few large spots.

Female.—Length, 4 mm; wing, 4.2 mm. Head: rostrum and palpi dark brown; antennæ uniformally brown; front, vertex and occiput grayish-brown with a darker linear brown spot on vertex.

Thorax: pronotum white, the scutellum pale brown on the middle line, giving the appearance of being divided. Mesonotum: præscutum dull gray; the extreme lateral margins narrowly white; continued caudad from the end of the prothoracic scutellum; a broad sublateral band beginning near the pseudosuture, continuing caudad, indistinct, brown. The lateral bands on either side of the broad

[1] In the figure, No. 28, the vein *Sc* was accidentally omitted.

Digitized by Google

medial ground band very narrow, far removed from the tuberculate pits. Tuberculate pits separated from one another by a distance equal to one and one-half the diameter of either; pseudosuture elongate, rather deep; pits and pseudosuture shiny black. The space in front of the pseudosuture pale, whitish. Scutum dull gray with two brown stripes on either side of the middle line, continuations of the præscutal stripes; scutellum pale, grayer anteriorly, a large oval brown medial spot; post-notum dull gray with a narrow black medial line. Pleural stripes rather indistinct; ground color whitish with two oblique brownish bands, one along the dorsal edge of the epipleural sclerites, the second along the ventral edge of these sclerites; sternum gray with two indistinct brown bands. Halteres pale, knob darker. Legs—Fore: brownish yellow; femora, apical half dark brown with a subapical band of pale yellow hairs; tibia dark basally, remainder of tibia and three basal tarsal segments whitish; two apical tarsal segments brown. Middle: femora, dull yellow with an apical brown band; tibia and tarsi as in the foreleg. Hind: femora, apical half dark brown with a very narrow yellow subapical band; tarsi and tibiæ as in the foreleg.

Wing: cells A, Cu, M and caudal half of R almost hyaline; cells C, Sc and cephalic half of R brown with large spots; one at the base, one at the origin of Rs, one at Sc_2, one at cross vein *r* and fork of R_{2+3}; apices of cells R_2, R_5, M_1, brown; also narrow margins along most of the veins in the caudal half of the wing. (See fig. 25.)

Abdomen: brown, apices of the tergal segments paler.

Male.—Similar to the female but has a narrow brown line running along the middle of the mesothoracic præscutum, making the thoracic dorsum tri-vittate; this stripe ends far before the suture; the brown on the wings is less extensive, producing a very pale picture. Legs rather darker, especially the middle femora.

Habitat.—Holotype.—Female, Salina Cruz, Oaxaca, Mexico (Fredk. Knab). *Allotype.*—Male, Vera Cruz, Vera Cruz, Mexico, December 14, 1907 (F. Knab). *Paratype.*—Sex (?), Acapulco, Mexico (F. Knab).

Type.—In U. S. National Museum collection (No. 14924).

ERIOPTERA (MESOCYPHONA) EISENI, new species.

Vertex variegated; mesonotum light brownish-yellow; pleural stripes rather distinct; wings brownish, the spots only on the veins, few in number (about 16) and subequal.

Male.—Length, 3.3–3.6 mm; wing, 3.1–3.2 mm.

Female.—Length, 3–3.3 mm; wing, 3.2–3.4 mm.

Head: rostrum and palpi dark brown; antennæ pale yellow throughout; outer margin of the front and vertex along the inner side of the eye, light yellow; rest of the head brown.

Thorax: pronotum, scutum light yellow; scutellum pale whitish. Mesonotum: præscutum light brownish-yellow, extreme lateral mar-

Digitized by Google

gins of the sclerite white, caudad of this broadly brownish, especially behind; the stripe confluent in front; a rather broad uniform stripe on either side of the middle line; tuberculate pits and pseudosuture very pale, reddish; the pseudo-suture very shallow, not prominent, located in the pale patch between the brown præscutal stripes. Scutum yellowish-brown with four stripes, continuations of the uninterrupted præscutal stripes; scutellum and post-notum yellowish-brown, the latter darker medially. Pleuræ light brown; a narrow white oblique stripe runs from the cervical region back toward the wing-basis; a very broad white area, originating behind the precoxa, running backward obliquely to the halteres, narrowest anteriorly. Sternum pale greyish-brown with a pale stripe across the post and meso coxæ. Halteres white except the knob, which is darker. Legs: coxæ and trochanters white; femora pale yellowish, palest at the extremities, with an indistinct brown subapical ring; tibiæ and tarsi pale yellowish-white, last two tarsal segments darker.

Wings: costal, subcostal, and radial cells brown; median, cubital and anal cells grey; about sixteen large rounded spots on the wing arranged about as follows: (1), in base of cell R; (2), under origin of Rs; (3), at Sc_2; (4), at tip of Sc_1; (5), at tip of R_1; (6), at fork of R_{2+3}; (7), several confluent along the cord; (8), at the tip of each of the longitudinal veins; (9), at fork of M_{1+2}, and (10), in cell R_5. (See fig. 26.)

Abdomen: brown with an indistinct darker median line on the tergum.

Habitat.—Holotype.—Male, Aguna, Guatemala, Central America (2,000 feet) (G. Eisen). *Allotype.*—Female, with the type. *Paratypes.*—Three males, three females with the type.

Type.—In U. S. National Museum collection (No. 14923).

ERIOPTERA (MESOCYPHONA) COSTALIS, new species.

Vertex unicolorous, clear brown; mesonotum clear brown, narrowly trivittate; pleural stripes indistinct. Legs pale except a narrow subapical band on femora; costal and subcostal cells of wings dark with a few small dots.

Male.—Length, 2.8 mm.; wing, 2.9 mm. Head: rostrum and palpi dark brown; antennæ, front, vertex and occiput clear light brown.

Thorax: pronotum light yellow, the scutellum rather darker medially. Mensonotu: præscutum uniformly light brown with three very narrow indistinct dark brown lines, the medial one beginning at the cephalic margin of the sclerite, continuing backward, passing between the tuberculate pits; lateral stripes indistinct at the ends, strongly bent proximad near the middle by the pseudosuture. Tuberculate pits separated from one another by a distance equal to one and one-half the diameter of either; pits black; pseudosuture elongate

Digitized by Google

deep, pale reddish; scutum grayish brown, trivittate; scutellum, gray, broadly two-striped; post-notum dark. Pleuræ uniformly light brown without conspicuous stripes. Halteres pale, knob brown. Legs: brownish yellow, a narrow dark subapical ring on the femora.

Wings: cells C and Sc rather dark brown, with a few small inconspicuous dots; caudal cells pale, subhyaline. The picture of the wing is that of a dark costal area and the remainder of the wing pale. (See fig. 24.)

Abdomen: yellowish brown, a median tergal stripe, broadest on the first segment; lateral margin of the tergites darker.

Female.—Length, 5.7 mm; wing, 4.3 mm. Larger, the caudal cells of the wing darker, numerously dotted and sprinkled with paler.

Habitat.—Holotype.—Male, Aguna, Guatemala, C. Am. (G. Eisen, coll.). *Allotype.*—Female, Cayamas, Cuba. March 18 (E. A. Schwarz); (in house).

Type.—In U. S. National Museum collection (No. 14925).

ERIOPTERA (MESOCYPHONA) CALOPTERA Say; FEMORANIGRA, new subspecies.

Like *caloptera* Say in its variegated vertex, yellowish mesonotum, wing pattern, etc., but much darker in coloration, especially in the posterior femora.

Præscutal pits separated by a distance not greater than the diameter of one; located on the proximal edge of the dorsal thoracic stripes, these stripes as wide as, or wider than, the pale dorsal median stripe; hind femora largely black, the yellow being confined to the extreme tip, the base, and a narrow post medial ring.

This subspecies is closely allied to the more northern *caloptera* in its coloration and structure; the indistinct brown pleural stripes, the shape and position of the præscutal stripes, the wing pattern, etc. A notable and apparently constant difference, however, is in the posterior femora which are mostly black in the tropical form, the antepenultimate (yellow) ring being narrower than the penulimate (black) ring, and other clearly defined differences. In some specimens the last black ring is continued to the tip of the femur, obliterating the yellow apex of the segment. This is apparently merely a dark southern form of the species.

Habitat.—Holotype.—Female, Juan Vinas, Costa Rica, May 2, 1910; (P. P. Calvert) (in house). *Paratypes.*—Three females, with the type.

Type.—In Philadelphia Academy of Natural Sciences.

ERIOPTERA (MESOCYPHONA) IMMACULATA, new species.

Vertex brown anteriorly, more yellow behind; mesonotum grayish-yellow, stripes broad; pleural stripes distinct; femora with a narrow sub-apical band; wings unspotted

Digitized by Google

Male.—Length, 2.3 mm; wing, 2.9 mm.

Female.—Length, 2.2–3.4 mm.; wing, 3.9–4 mm.

Head: rostrum and palpi brown; antennæ, two basal segments dark brown, flagellum brown with pale hairs; front and vertex brown, the caudal portion of the vertex and the occiput dull yellow.

Thorax: pronotum light yellow above, on sides deep brownish-black forming a U-shaped mark around the scutum. Mesonotum: extreme lateral edges of the præscutum pale white, pale median stripe rather broad, grayish-yellow, pale lateral stripes, strongly tinged with brown, the usual brown stripes, broad, distinct; scutum brownish-yellow with four brown stripes; scutellum pale; postnotum pale, darker caudad. Tuberculate pits dark brown, separated from one another by a distance equal to from one and one-half to two times the diameter of either. Pseudosuture rather deep, elongate, broadest at the proximal end, pale brown. Pleuræ with distinct alternate dark and pale stripes, there being three brown and two pale, the second pale band is broad, silvery white; sternum dull gray. Halteres pale, knob brown. Legs: coxa grayish; trochanter yellow; femora dark yellow with a narrow brown subapical ring; tibiæ and tarsi yellow, the tarsal segments 3 to 5 darker, brownish.

Wings: hyaline unmarked; veins brown; costa more yellowish; an indication of darker along vein Cu. (See fig. 20.)

Abdomen: tergum dark brown, with no distinct darker median stripe; sternum brown.

Habitat.—Holotype.—Male, Bluefield, Nicaragua, November, 1900 (L. A. Wailes). *Allotype.*—Female, Córdoba, Mexico, December 25, 1907 (F. Knab). *Paratypes.*—One female, one male, Aguna, Guatemala (D. G. Eisen); one female, Córdoba, Mexico, December 23, 1907 (F. Knab).

Type.—In U. S. National Museum collection (No. 14926).

The Guatemalan specimens are very small, but undoubtedly belong to the same species.

ERIOPTERA (MESOCYPHONA) BICINCTIPES, new species.

Resembles *E. immaculata* of Mexico and Central America in its unspotted wings. It differs as follows: Flagellum of the antennæ much lighter colored (yellow) than the brown scape. Thorax: pronotum light colored (whitish) with a V-shaped mark on the scutum, very conspicuous. Mesonotum: yellowish, brown stripes not clear cut. Femora with the usual subapical brown band and with a subequal post-median band, this latter marking less strongly indicated on the forelegs.

Ten specimens, one male, nine females.

Digitized by Google

Habitat.—*Holotype.*—Male, Igarape Assu, Pará, Brazil, January 25, 1912 (Parish Coll.). *Allotype.*—Female, with the type, February 7, 1912. *Paratypes.*—Eight females, with the type.

Type.—In Cornell University collection. *Paratypes* in author's collection.

ERIOPTERA (EMPEDA) NIGROLINEATA Enderlein.

Empeda nigrolineata ENDERLEIN, Zoöl. Jahrb., vol. 32, 1912, pp. 56, 57, fig. H[1].

The species is allied to *E. stigmatica* Osten Sacken, especially in the variety *pubescens*. This race differs in having the pubescence of the wing, lack of the stigmal spot, and in color. Typical *nigrolineata* can not be mistaken for *stigmatica* by its very striking coloration.

A redescription of typical *nigrolineata*, based on forty specimens, is as follows:

Male.—Length, 3–3.3 mm.; wing, 4.8–5 mm.

Female.—Length, 3.9–5 mm.; wing, 5.1–6 mm.

Head: rostrum and palpi dull yellow, the latter more brownish; antennæ brown; front, vertex, and occiput brown, the vertex paler, yellow, in the vicinity of the eyes.

Thorax: light reddish-brown with a dark brownish-grey median stripe, broadest on the pronotum, where the whole sclerite is included, narrowing behind, becoming indistinct before the suture. Tuberculate pits close together, separated by a distance about equal to the diameter of one; pseudo-suture pale, reddish, shiny. Lateral margins of the præscutum pale yellow, scutum, scutellum and post-notum light reddish-brown. Pleuræ yellow, with a faint bluish tinge; no stripes. Haltere light yellow, knob slightly darker, brownish. Legs dull yellow, the tarsi darker, yellowish-brown.

Wings hyaline; veins light brownish-yellow.

Abdomen: light yellowish-red, base darker, brown; hypopygium yellow.

I have had for study a series of 49 specimens from the United States National Museum collection. These were collected by G. Eisen, Totonicipan, Guatemala, Central America, July, 1902. Forty of these are referable to typical *nigrolineata;* nine are referable to the following variety:

ERIOPTERA NIGROLINEATA, var. PUBESCENS, new subspecies.

The head above is uniformly light grey, the dark stripe of the thoracic dorsum broad, on the præscutum expanded out over the entire sclerite with the exception of the anterior margin and the space in front of the pseudo suture. Pleuræ greyish with an indistinct broad yellowish stripe above the foreleg and running caudad beyond the wing basis; wings strongly tinged with yellow at the bases; a distinct, though sparse, pubescence in all of the cells of the wings.

Digitized by Google

Genus SIGMATOMERA Osten Sacken.

Sigmatomera OSTEN SACKEN, Monographs, vol. 4, 1869, pp. 137, 138.

1. Cell first M_2 distinct; brown crossband on the wing narrow, confined to the cord (Mexico)..... *flavipennis* Osten Sacken.[1]
2. Cell first M_2 not distinct (cross vein *m* obliterated); brown crossband broad; base and tip of the wing brown (Brazil)..... *amazonica* Westwood.[2]

No representatives of this genus were included in the material studied.

Genus GNOPHOMYIA Osten Sacken.

Gnophomyia OSTEN SACKEN, Proc. Acad. Nat. Sci. Phila., 1859, p. 223.
Furina JÆNNICKE, Abhandl. Senckenb, Ges., vol. 6, 1867, p. 318.—OSTEN SACKEN, Monographs, vol. 4, 1869, p. 172; Studies, etc., pt. 2, 1887, p. 198.

KEY TO THE SPECIES OF GNOPHOMYIA.

1. Cross vein *m* absent..... *aperta* Coquillett[3] (S. W. Canada).
   Cross vein *m* present..... 2.
2. Wings uniform in coloration without dark fasciæ..... 3.
   Wings light colored with dark fasciæ, or dark colored with white fasciæ..... 9.
3. Wings strongly tinged with blackish or dark brown, uniform..... 4.
   Wings subhyaline, or very slightly darker..... 8.
4. Halteres with the knob yellow..... *tristissima* Osten Sacken[4] (Eastern U. S.).
   Halteres entirely dark colored..... 5.
5. Thorax black..... 6.
   Thorax orange..... 7.
6. Small species (length about 4 mm); wings infumed with violaceous; stigma brown..... *nigrina* Wiedemann[5] (Brazil).
   Larger species (length about 6–7 mm); wings nearly black; costal cell darker; no distinct stigma..... *luctuosa* Osten Sacken (E. U. S.; Cent. Am.).
7. Abdomen black..... *rufithorax* Wiedemann (Brazil).
   Abdomen orange..... *magnifica*, new species (Mexico).
8. Dark rust red; wings uniformly tinged with brown. *ferruginea* Williston[6] (Mexico).
   Greyish brown; wings very faintly tinged with brown; an indistinct hyaline cross band beyond the cord ..... *subhyalina*, new species (Cent. Am., Brazil).
9. Wings subhyaline with two brown fasciæ..... 10.
   Wings brown with two subhyaline crossbands. *caloptera* Osten Sacken[7] (Brazil, probably).
10. Body, halteres and legs altogether black..... *osten sackeni* Skuse[8] (Brazil).
    Body light yellow, with brown marks..... *hirsuta*, new species (Brazil).

I have not included in the above table, *Gnophomyia* (?) *stupens* Walker[9] on the grounds that it is unrecognizable. In the original description, the venation is compared to a *Tricyphona*, but Osten Sacken says that it is a *Gnophomyia*. No species known to me has

[1] Monographs, Dipt. N. Amer., vol. 3, p. lx (supplement, Smiths. Misc. Coll., No. 256 (1873)).
[2] Trans. Ent. Soc. Lond., 1881, p. 366, pl. 17, fig. 3.
[3] Journ. N. Y. Ent. Soc., 1905, p. 58.
[4] Monographs, vol. 4, p. 175, pl. 2, fig. 5 (wing); male and female.
[5] Auss. Zweifl. Ins., 1828, vol. 1, p. 37 (*Limnobia*).
[6] Biologia Centrali-Americana, Diptera, vol. 1 (supplement), Dec., 1900, p. 226, female.
[7] Studies on Tipulidæ, pt. 2, Berl. Ent. Zeit., 1887, pp. 199, 200, male and female.
[8] Osten Sacken, Idem, p. 200, female.
[9] Trans. Ent. Soc. Lond., new ser., vol. 5, 1860, p. 333 (*Limnobia*).

Digitized by Google

brown on the costa and along the veins, and at the same time is large enough (12 mm) to answer this description. It agrees very well with the Mexican Trimicræ.

GNOPHOMYIA LUCTUOSA Osten Sacken.

Gnophomyia luctuosa OSTEN SACKEN, Proc. Acad. Nat. Sci. Phila., 1859, p. 224, male; Monographs, vol. 4, 1869, p. 174; Cat. Dipt. N. Amer., 1878, p. 30; Berl. Ent. Zeit., vol. 31, 1887, p. 198.—JOHNSON, Proc. Acad. Nat. Sci. Phila., 1895, p. 320.—KERTESZ, Cat. Dipt., vol. 2, 1902, p. 210.—ALDRICH, Cat. N. Amer., Dipt., 1905, p. 87.

Limnobia nigricola WALKER, Trans. Ent. Soc. Lond., 1860, p. 333.

One female from Guatemala, Central America (Sept., 1902) (Coll. G. Eisen.).

Length, 6 mm.; wing, 6.3 mm.

Specimen in U. S. National Museum collection. (See fig. 29.)

GNOPHOMYIA RUFITHORAX Wiedemann.

Limnobia rufithorax WIEDEMANN, Auss. Zweifl. Ins., vol. 1, 1828, p. 548, male.

Furina rufithorax JÆNNICKE, Abhandl. Senckenber. Ges., vol. 6, 1867, p. 318, pl. 43, fig. 1.

Gnophomyia rufithorax OSTEN SACKEN, Berl. Ent. Zeit., vol. 31, 1887, p. 198.—HUNTER, Trans. Amer. Ent. Soc., 1900, p. 291.—KERTESZ, Cat. Dipt., vol. 2, 1902, p. 211.

Male.—Somewhat injured, head missing.

Thorax: pronotum black, reddish along the caudal margin. Mesonotum: yellowish-orange, darker, brownish, behind. Pleuræ orange, the meso- and meta-coxæ orange at the bases. Legs black.

Wings brown, posterior cells paler. (See fig. 32.)

Abdomen black.

Male, wing 11.5 mm.

Chapada, Matto Grosso, Brazil (March) (H. H. Smith, coll.) (specimen in American Museum of Natural History).

GNOPHOMYIA MAGNIFICA, new species.

Head, legs and wings black; thorax and abdomen orange-yellow.

Female.—Length 14 mm.; wing, 13 mm.

Head: rostrum and palpi dark brownish-black. Eyes rather approximated; antennæ entirely black. Front, vertex and genæ black, occiput dull orange-yellow; front shiny.

Thorax: pronotum, scutum bright orange-yellow, darker in front, paler behind; scutellum narrow, transverse, pale yellow. Mesonotum: præscutum deep orange-yellow without stripes, a row of hairs along either side of the middle prominence, passing mesad of the pseudosutural fovea, a rounded whitish spot occupying the region of the pseudo-suture, lateral margins of the sclerite paler, light yellow; scutum, scutellum and post-notum orange-yellow, the latter slightly suffused with brown, especially medially. Pleuræ

Digitized by Google

orange-yellow, darker near the sternum and on the coxæ. Halteres black, brown at the extreme bases. Legs: coxæ yellowish-brown; trochanters, femora, tibiæ and tarsi jet black.

Wings deep shiny-black throughout. (See fig. 31.)

Abdomen: deep orange throughout.

Holotype.—Female, Cuernavaca, Mexico (D. L. Crawford, coll.).

Type.—In collection of Prof. C. F. Baker, Pomona College.

GNOPHOMYIA SUBHYALINA, new species.

Grayish-brown; legs unicolorous, except tarsi; wings subhyaline, very pale brown with a hyaline cross-band.

Male.—Length, 4.8–6 mm; wing, 4.8–6.1 mm.

Female.—Length, 5.2–7 mm; wing, 5–6.8 mm.

Head: palpi and rostrum dark brown; antennæ, basal segments yellowish-brown, flagellum medium brown, the segments covered with a dense pale pubescense. Front, vertex and occiput gray, tinged with brown.

Thorax: pronotum: scutum grayish-brown; scutellum light yellow, brightest laterally. Mesonotum: grayish-brown, without stripes; pseudo-suture prominent, triangular, with a prolongation extending lateral to the caudal end of the prothoracic scutellum, dark brown scutum grayish-brown, more yellowish on the sides nearest the wing bases; scutellum and post-notum medium brown. Halteres brownish-yellow, knob pale. Legs: coxæ and trochanters pale yellow; femora, tibiæ and most of tarsal segments one and two brown; remainder of the tarsi brownish-black.

Wings: subhyaline, veins dark brown; wings very faintly tinged with brown; a broad hyaline band which crosses the wing distad of the cord is broadest posteriorly; venation (see fig. 23).

Abdomen: tergum dark brown; sternum lighter yellowish-brown.

The paratypes are rather smaller, but undoubtedly belong to the same species.

Habitat.—*Holotype.*—Cacao, Trece Aguas, Alta Vera Paz, Guatemala, April 2 (Schwarz and Barber, coll.). *Allotype.*—Same place as the type, April 20. *Paratypes.*—Male, Montserrat, Trinidad, West Indies, June, 1897 (Aug. Busck, coll.). Three males, seven females, Aguna, Guatemala, Central America (G. Eisen, coll.). One female, Igarape Assú, Pará, Brazil (H. S. Parish, coll.).

Types.—In U. S. National Museum collection (No. 14931).

GNOPHOMYIA HIRSUTA, new species.

Thorax light yellow with four stripes; legs with dark tips to the femora, tibiæ and tarsi; wings hyaline with two conspicuous brown bands.

Female.—Length, 7 mm.; wing, 6.6 mm. Head: rostrum and palpi yellowish-brown; antennæ, basal segments brownish-yellow, flagellum

Digitized by Google

lighter yellow, segments with numerous long black hairs. Front, vertex and occiput dull yellow with a brown tinge; genæ clearer brown.

Thorax: pronotum light yellow. Mesonotum: præscutum covered with a thick pubescence, light yellow with two brown stripes on either side of the median line, these stripes pale, yellowish-brown in front; a large rounded brown spot on the sides of the sclerite before the pseudosuture; scutum, scutellum and post-notum brown, the latter darker. Pleuræ light yellow with a broad brown band running from the side of the pronotum backward under the wing-bases to the post-notum; sternum light brown. Halteres broken, stem yellow. Legs light yellow, a light brown ring at the tip of the femora, a darker one at the tip of the tibiæ; tarsi, tip of segment 2, all of 3 to 5 dark brown; legs densely hairy.

Wings: hyaline with two brown bands, one traversing the wing-basis, extending from near the humeral cross vein to the origin of the sector, narrower in the anal cells. The second band is in the vicinity of the cord, cells second R_1 almost all included, base of cell R_3, tip of cell R, base of cells R_5 and first M_2; a prominent brown cloud at the basal deflection of Cu_1 and along the second deflection of M_3 and cross vein *m* (outer end of cell first M_2); a very pale brown cloud extends across the cells R_2, R_3, R_5, and M_2. Venation (see fig. 30).

Abdomen: tergum light yellow; all except segment 5 with the sclerite largely brown, especially caudally and laterally; segment 5 clear yellow; sternum light yellow.

Holotype.—Female, Rio de Janiero, Brazil (November) (coll. H. H. Smith).

Type.—In American Museum of Natural History.

Genus TRIMICRA Osten Sacken.

Trimicra Osten Sacken, Proc. Acad. Nat. Sci. Phila., 1861, p. 290; Monographs, vol. 4, 1869, p. 165; Studies, etc., pt. 2, 1887, p. 195.
Ilisia Rondani, Prodr., vol. 1, 1856, p. 182.

KEY TO THE AMERICAN SPECIES OF TRIMICRA.

1. Antennæ uniformly brown; wings not pubescent; large species, length, 7 mm. or over.....*anomala* Osten Sacken.[1]
   Antennæ with the basal segments yellow; wings pubescent; small species, length, 5 mm. or less.....*pygmæa* Alexander.[2]

In the United States National Museum collection is a series of specimens from Mexico which agree very well with the description of *T. anomala*, and I have determined them as such. As to whether or not this species is conspecific with the European *Trimicra pilipes* Fabricius, as given by Osten Sacken in his Western Diptera, page 200,

[1] Proc. Acad. Nat. Sci. Phila., 1861, p. 290; Monographs, vol. 4, p. 167.
[2] Psyche, vol. 19, Dec., 1912, p. 166, pl. 13, fig. 3.

Digitized by Google

I will not attempt to decide without having European material for comparison. The data for the Mexican specimens are as follows:

Córdoba, Mexico, December 18, 1907, male and female; February 11, 1908, male and female; February 16, 1908, two females; March 12, 1908, three females; March 16, 1908, male. Orizaba, Mexico, March 13, 1908, male and female (Fred. Knab, coll.).

KEY TO THE GENERA OF THE LIMNOPHILINI.

(Based largely on Needham's key, 1907.)

1. Ocelli present.....2.
   Ocelli absent.....3.
2. Cell M_1 present; basal deflection of Cu_1 near the outer margin of cell first M_2 (i. e., fusion of Cu_1 and M, very slight).....*Trichocera* Meigen.
   Cell M_1 absent; basal deflection of Cu_1 at, or near, the fork of M (i. e., fusion of Cu_1 and M extensive).....*Ischnothrix* Bigot.
3. Radial cross vein absent.....*Phyllolabis* Osten Sacken.
   Radial cross vein present.....4.
4. Cross vein *m* absent; fusion of M_3 and Cu_1 long and ending in a symmetrical fork.....*Polymera* Wiedemann.
   Cross vein *m* present; fusion of M_3 and Cu_1 usually short; fork not symmetrical..5.
5. Wings pubescent; two branches of M.....*Ulomorpha* Osten Sacken.
   Wings glabrous (usually); if pubescent, three branches of M at the wing margin..6.
6. A supernumerary cross vein in cell C.....*Epiphragma* Osten Sacken.
   No supernumerary cross vein in cell C.....7.
7. Antennæ of male with long pectinations; usually with more than 16 segments. *Ctedonia* Philippi.
   Antennæ of male of various shapes, but never pectinate; 16-segmented.....8.
8. Sc very long, approximating R_1 at wing-margin.....*Lecteria* Osten Sacken.
   Sc shorter, always distant from R_1 at the tip.....*Limnophila* Macquart.

Genus ISCHNOTHRIX Bigot.

Ischnothrix BIGOT, Miss. Sci. Cape Horn, Zoöl., pt. 6, 1888, pp. 7, 8, pl. 2.

Male.—Related to the genus *Trichocera.* Antennæ hair-like, two or three times as long as the body, with 13 or 14 (?) segments, segment 1 short, stout, second scarcely visible, the remainder elongated, cylindrical, attenuated apically; rostrum almost as long as the head, horizontal, abruptly truncated at the tip; palpi 5 segmented, the fifth not much longer than the others, indistinctly furrowed; three ocelli; feet very long, smooth, not swollen; wings margined with short hairs, twice as long as the abdomen; first and second longitudinal (Rondani) veins separate at their tips; three veins emerge from the pentagonal discal cell, widely separated basally, not forked; from the first basal cell, two veins, the outer forked; hypopygium small, clasping; abdomen scantily clothed with fine hairs on both sides. (Bigot).

ISCHNOTHRIX ÆTHERREA (Bigot).

Male.—Eight mm. Antennæ testaceous, broadly infuscated at the tip; palpi black; rostrum brown, tip tinged with black; head

Digitized by Google

brown, front with a median brown vitta; thorax reddish, tinged with dull brown; halteres whitish; abdomen testaceous, incisures infuscated; feet testaceous; wings almost hyaline, in the middle slightly tinged with whitish; stigma small, black; transverse veins and the third longitudinal vein at the base margined with brown.

Translated from Bigot's original description. His figure shows an insect with a moderately long Sc_1; Sc_2 not far from the tip of Sc_1; R_{2+3} long fused, much longer than either R_2 or R_3, which are subequal; M_{1+2} fused to the wing margin; the outer deflection of M_4 about equal to the cross-vein *m;* basal deflection of Cu_1 at the fork of M. The anal angle of the wing is prominent.

Genus POLYMERA Wiedemann.

Polymera Wiedemann, Dipt. Exot., vol. 1, 1821, p. 40.—Osten Sacken, Monographs, vol. 4, 1869, p. 335; Studies, etc., pt. 2, 1887, p. 215.

The genus *Polymera* is a very characteristic one in the Neotropical regions. Almost every collection brought from South or Central America includes specimens of this interesting group, and it is very probable that it will ultimately prove to be one of the largest genera of the tropical crane-fly fauna. One species, *Polymera magnifica* Meunier,[1] has been described as fossil.

The recent species hitherto described, five in number, range from Brazil to the southeastern United States. I have had for study about 25 specimens which included all of the known species, excepting *fusca* Wiedemann and *albitarsis* Williston, as well as seven new forms. The males, as now known, are all characterized by extremely elongated antennæ, at least as long as the body, and usually clothed with long delicate, outstretched hairs. The antennal segments may be elongate-cylindrical and not constricted (*niveitarsis* and possibly *fusca*), or they may be constricted once, producing a bi-nodose effect (most of the species), or constricted twice, producing a tri-nodose appearance (*pleuralis*). Specialization in wing venation is also evident, ranging from a generalized form like *niveitarsis* with deep forks, through *pleuralis* which has lost one of the forks (M_{1+2} fused to the margin) but still has a deep medio-cubital fork, to *conjuncta*, which shows a decided tendency for Cu_1 and M_4 to fuse to the wing-margin.

Wiedemann does not say that the antennæ of the female *fusca* are elongated like those of the male (as described by Williston, Dipt. St. Vincent, p. 297). The sex of the specimen that he figures is not given, but it is undoubtedly a male. The venation and antennæ are so similar to *niveitarsis* that it would not be surprising if the second specimen that Wiedemann possessed[2] from the Frankfort Museum proved to belong to that species.

[1] Ann. Sci. Nat. Zoöl., vol. 4, p. 385, pl. 14, figs. 11, 12; pl. 15, fig. 2; pl. 16, fig. 1.
[2] Auss. Zweifl. Ins., vol. 1, p. 554.

Digitized by Google

Antennæ: first segment broadly oval-cylindrical; second short, oval-cylindrical, much narrower than the first; third segment elongate-cylindrical, not constricted, with long delicate hairs; segments 4 to the end, constricted at the ends, and constricted once or twice medially, producing a bi-nodose or tri-nodose appearance. As previously stated, some (as *niveitarsis*) have simple flagellar segments; at the nodes, the segments are clothed with long outstretched hairs which are much longer than the segments which bear them; interspersed with these are very short, prominent bristles, and over the whole segment is a fine delicate pubescence.

Palpi: first segment very short, second and third subequal in diameter and length; fourth about as long as 2 and 3 together, narrower than either.

Venation: Sc_2 at, or near, the tip of Sc_1; R long, R_1 usually far back from its tip; M_1 and M_2 usually separate at the wing-margin; M_3 and Cu_1 fused for a considerable distance, when separating, the fork symmetrical; cross vein *m* absent.

Genitalia: male (*obscura*); pleuræ very long, cylindrical, thickly clothed on the external facies with long hairs; two apical appendages; anal tube broad, distinct; guard of the penis scarcely visible from the exterior.

KEY TO THE SPECIES OF POLYMERA.

1. Cell M_1 entirely absent.....2.
   Cell M_1 present.....3.
2. Large species (wing 6.2–6.8 mm.); Cu_1+M_3 shorter than M_3 alone; pleuræ dark; tarsi white.....*pleuralis*, new species (Brazil).
   Small species (wing 3–3.5 mm.); Cu_1+M_3 longer than M_3 alone; pleuræ not dark; tarsi not white.....*conjuncta*, new species (Brazil).
3. Wings not uniform in coloration.....4.
   Wings uniform in coloration.....6.
4. Wings dark colored with lighter spots or fasciæ.....5.
   Wings hyaline, or nearly so, with small brown spots at the forks of most of the veins.....*obscura* Macquart (Brazil).
5. Wings with white or whitish spots.....*superba*, new species (Costa Rica, Brazil).
   Wings with a light yellow cross-band.....*hirticornis* Fabricius (Brazil).
6. Flagellar segments of the antennæ elongate-cylindrical, not noticeably constricted.....7.
   Flagellar segments of the antennæ constricted once or twice, giving a multi-segmented appearance to the antennæ.....8.
7. Tarsi of all the legs white.....*fusca* Wiedemann[1] (Brazil).
   Only tarsi of hind legs white.....*niveitarsis*, new species (Guat., Brazil).
8. Fore and middle tarsi more or less yellowish-white or white.....9.
   Fore and middle tarsi dark, about concolorous with the tibiæ.....11.
9. Antennæ conspicuously annulated, rather short (about as long as the body). *georgiæ* Alexander[2] (Southeast U. S.).
   Antennæ not conspicuously annulated, much longer than the body.....10.

[1] Auss. Zweifl. Ins., vol. 1, pp. 58 and 554, pl. 6b, figs. 3–4. Original description in Dipt. Exot., vol. 1, p. 44.

[2] Psyche (Dec., 1911), pp. 199, 200, fig. 5.

Digitized by Google

KEY TO THE SPECIES OF POLYMERA—continued.

10. Thorax light-colored; brownish-yellow with a narrow dark pleural stripe; wings brown.....*albitarsis* Williston[1] (Lesser Antilles).
Thorax uniform in color, dark brown; wings gray..*thoracica*, new species (Brazil).
11. Large species; length (male) 4.5 mm.; wing 4.7 mm.; distance of R_1 beyond *r* equal to that space between Sc_2 and *r*; wings yellowish.
inornata, new species (Brit. Guiana).
Small species; length (male) 3 mm.; wing 4.6 mm.; distance of R_1 beyond *r* much less than that space between Sc_2 and *r*; wings gray.
grisea, new species (Panama).
(Probably here; see description.)

POLYMERA PLEURALIS, new species.

Size medium; flagellar segments of the antennæ tri-nodose; wing with cell M_1 absent; M_3+Cu_1 much shorter than M_3 alone; tarsi white or whitish; thoracic pleuræ with a broad black stripe.

Length, male, 5 mm.; female (to tip of ovipositor), 6.6–6.8 mm.; wing, male, 6.4 mm.; female, 6.2–6.8 mm.; antennæ, male (about), 8.5 mm.; hind leg, female, femur, 5.4 mm.; tibia+tarsus, 8.6 mm.

Male.—Palpi and rostrum light brown, the latter more yellowish; eyes large, conspicuous, leaving the vertex narrow between the eyes; vertex grayish; occiput brownish-gray. Antennæ, basal segment dark brown, second lighter brown, third elongate-cylindrical fifth to near the end (most noticeable in the region of the tenth segment) constricted twice, producing a tri-nodose effect, segments brown, the extreme base and tip paler, yellowish, giving an annulated appearance to the antennæ.

Thorax: dorsum uniform light brown; pleuræ very broadly dark brownish-black, extending from the cervical sclerites to the abdomen, this color encroaching on the fore coxa; sterna pale whitish-yellow. Halteres light brown, the knob rather dark. Legs: coxæ, trochanters and extreme base of the femora pale whitish-yellow, remainder of the femora and the tibiæ pale brown, darker at the extreme tip; tarsi yellowish-white, except the last segment, which is brown.

Wings: uniformly tinged with light brown. Venation: Sc rather long, ending about opposite the fork of R_{2+3}; Rs not gently arcuated at its basis, but rather square; R_1 beyond the cross-vein *r* about two-fifths the distance from Sc_2 to *r*; R_{2+3} short, shorter than the basal deflection of Cu_1; basal deflection of R_{4+5} longer than *r–m*. M_{1+2} fused to the wing-margin. M_3+Cu_1 short, only about two-fifths as long as Cu_1 beyond the fork. (See fig. 17.)

Abdomen blackish, sternum little, if any, paler.

Female.—Quite similar to the male, but antennæ short, normal in appearance, not annulated; if bent backward, would extend about to the base of the abdomen. In color and venation, as in the male.

[1] Trans. Ent. Soc. Lond., 1896, p. 296, pl. 10, fig. 71.

Digitized by Google

Habitat—Holotype.—Male, Igarape Assú, Pará, Brazil; February 4, 1912 (Parish). *Allotype.*—Female, Igarape Assú, Pará, Brazil; February 7, 1912 (Parish). *Paratype.*—Female, Igarape Assú, Pará, Brazil; January 19, 1912 (Parish).

Types.—In Cornell University collection.

Paratype.—In author's collection.

POLYMERA CONJUNCTA, new species.

Size small; flagellar segments of the antennæ bi-nodose; wing with cell M_1 absent; M_3+Cu_1 longer than M_3 alone; tarsi not lighter colored than the tibiæ; thoracic pleuræ unicolorous with the dorsum.

Male.—Length (abdomen unbroken); female, 2.8 mm.; wing, male, 3.5 mm.

Female.—Length, 3 mm.; antennæ, male, 4.4 mm.

Male.—Antennæ dark brownish-black, not annulated, the flagellar segments bi-nodose, deeply but broadly constricted medially; a group of outstretched hairs extending from each node.

Thorax light brown, rather yellowish; mesothoracic postnotum dark colored; pleuræ not clearly darker than the rest of the thorax. Halteres pale. Legs brown, the tarsi not paler, excepting the posterior tarsi, which are rather paler brown.

Wings light brownish-gray. Venation: Sc short, Sc_1 ending slightly before, or opposite to, the fork of Rs; Rs rather square at its origin; R_{2+3} long; basal deflection of R_{4+5} long. M_{1+2} fused to the wing margin. Cu_1+M_3 much longer than M_3 alone. Basal deflection of Cu_1 slightly before, or opposite to, the fork of M. (See fig. 7.)

Abdomen brown, darker than the thorax.

Female.—Antennæ short, segments simple, brown; coloration as in the male. Venation as in the male, but cross vein *r* inserted nearer to the fork of R_{2+3}, and R_2 is almost at a right angle to R_3 at its origin.

Habitat—Holotype.—Male, Igarape Assú, Pará, Brazil, Feb. 4, 1912 (Parish). *Allotype.*—Female Igarape Assú, Pará, Brazil, Feb. 4, 1912 (Parish).

Types.—In Cornell University collection.

POLYMERA OBSCURA Macquart.

Polymera obscura Macquart, Dipt. Exot., vol. 1, pt. 1, 1838, p. 65, pl. 8.—Williston, Trans. Ent. Soc. Lond., 1896, p. 297.—Hunter, Trans. Amer. Ent. Soc., vol. 26, 1900, p. 292.—Alexander, Psyche, 1911, p. 200.

Polymera fusca Kertesz, Cat. Dipt., vol. 2, 1902, p. 242.

Male.—Length, 5.2 mm.; wing, 5.8 mm.; antennæ, 7.5 mm. (about).; hind leg, femur, 4.6 mm.; tibia, 4.8 mm.; middle leg, femur, 4.8 mm.; tibia, 5.3 mm.

Digitized by Google

Head: rostrum and palpi dark brown; vertex brown, more yellowish anteriorly; occiput light brown. Antennæ, basal segment of the scape brown, second yellowish, third light brown, whitish apically, darker brown subapically, each succeeding segment of the antennæ bi-nodose, dark brown on the nodes, lighter brown at the constriction, and pale, almost white, at the ends.

Thorax: pronotum pale yellow: mesonotum, præscutum very light brownish-yellow with two broad dark brown stripes recurrent along the lateral margin of the sclerite; a broad lateral stripe extending from behind the pseudosuture to the transverse suture; pseudo-suture black, scutum light brownish-yellow medially with a dark brown line on either side; scutellum and postnotum brown, dusted with yellow. Pleuræ: dorsal portions of the epipleuræ dark brown, remainder of the epipleuræ brownish-black, deepest medially. Halteres light brown. Legs: coxæ and trochanters dull yellow; femora light brown, extreme tip light yellow, sub-apical ring black; tibia light brown, tip broadly black; tarsi white, the hindermost pair clearest white, anterior pair has the extreme tips of the segments indistinctly brown.

Wings: light gray, indistinct rounded clouds at the origin of Rs; along the cord; at the fork of R_{2+3}; at cross vein *r;* at the fork of M_{1+2}, and at the fork of M_3 and Cu_1. Venation: Sc rather long, Sc_1 ending rather nearer to the fork of R_{2+3} than Rs. Rs evenly arcuated at its origin, in a line with R_{2+3}; basal deflection of R_{4+5} arcuated; basal deflection of Cu_1 at the fork of M; M_3+Cu_1 longer than M_3 alone. (See fig. 18.)

Abdomen brown; sternum dark.

Hypopygium: posterior margin of the ninth tergite (*d*) produced caudad into a blunt, obtuse tooth; pleuræ (*c*) very long, cylindrical, thickly clothed on the external facies with long hairs, bearing two apical appendages, the upper one (*a*) is chitinized, cylindrical, blunt at the apex and there armed with a sharp, recurved hook; the lower appendage (*b*) is not chitinized, or only feebly so at its tip, rather shorter than the upper apical appendage and more pointed at its tip. On the ventral aspect, the ninth sternite is broadly concave; the anal tube (*e*) broad, distinct; guard of the penis entirely hidden from the ventral aspect, scarcely apparent from the dorsal aspect. (See fig. 1.)

Igarape Assú, Pará, Brazil (Parish), Jan. 19, 1912 (1 male); Jan. 30, 1912 (2 males); Feb. 4, 1912 (3 males).

Specimens in Cornell University collection and in author's collection.

POLYMERA SUPERBA, new species.

Size, medium; flagellum of the antennæ bi-nodose; cell M_1 present; wing dark-colored with white spots.

Male.—Length, 5.8 mm.; wing, 5.8 mm.; antennæ (about), 7.8 mm. Head: vertex dark chestnut-red, paler, yellowish, on the occiput;

Digitized by Google

front brown; rostrum reddish; palpi dark brown; antennæ: basal segments reddish-brown, third segment dull yellow at the base, remainder brown, paler, light yellow, at the tip, other segments constricted in the middle, with the extreme base and tip light yellow, producing an annulated effect.

Thorax: pronotum obscure yellow. Mesonotum: præscutum with the anterior half shining dull yellow; tuberculate pits large, comma-like, located well toward the cephalic margin of the sclerite; remainder of the sclerite black; scutum, scutellum and post-notum black; pleuræ: prothoracic obscure shining yellow; remainder of the pleuræ black. Halteres, stem and tip of the knob, yellow; remainder of the knob, brown. Legs: coxæ and trochanters dull yellow; fore leg broken. Middle leg: femora brown, the tip yellow or whitish-yellow, a broad black sub-apical band; tibia, basis yellow, remainder dark brown; tarsi, dark brown. Hind leg: femora yellowish-brown; tip whitish-yellow; a broad black subapical band; tibia, brown, paler at the extreme base; tarsi, base of segment 1 and segments 4 and 5 brown, remainder white, or whitish.

Wings: veins dark brown; cells C and Sc dull yellow; remainder of the wing subhyaline with brown markings; the whole apical third of the wing, a large spot connected with it and embracing the stigmal region and the cord, a large, interrupted basal blotch extending from the wing base to beyond the base of the sector, paler in the anal cells, a large spot in the ends of cells Cu and first A. Venation: Sc long, ending beyond the origin of Rs; *r* inserted far back from the tip of R_1 so that R_1 beyond *r* is about two-fifths of the distance on R_1 between Sc_2 and *r*. Rs rather square at its origin; R_{2+3} short, about as long as the basal deflection of Cu_1. Basal deflection of Cu_1 opposite the fork of M; M_3+Cu_1 equal to M_3 alone. (See fig. 2.)

Abdomen: tergum dark shining black; apical half of each segment paler, brown; hypopygium light reddish-yellow, the tips of the apical appendages brown; sternum, apical two-thirds of each segment brown, basal third black.

Allotype.—Female, length, 6.3 mm.; wing, 5.9 mm. Very similar to the male, the costal and subcostal cells of the wings are not yellowish but brown. The fore legs are present; apical two-thirds of the femora dark brownish-black; tibiæ and tarsi blackish.

Habitat.—Holotype.—Male, Tabernilla, Canal Zone, Panama (Aug. Busck).

Allotype.—Female, Igarape Assú, Pará, Brazil, January 24, 1912 (Parish).

Holotype.—In U. S. National Museum collection (No. 14935).

Allotype.—In Cornell University collection.

Digitized by Google

POLYMERA HIRTICORNIS Fabricius.

Chironomus hirticornis FABRICIUS, Syst. Antliar, 1805, p. 46.—WIEDEMANN, Dipt. Exot., vol. 1, 1821, p. 37, fig.

Polymera hirticornis WIEDEMANN, Auss. Zweifl. Ins., 1828, vol. 1, p. 57.—MACQUART, Suite à Buffon, vol. 1, 1834, p. 113.—HUNTER, Trans. Amer. Ent. Soc., vol. 26, 1900, p. 292.—KERTÉSZ, Catalogus Dipterorum, vol. 2, 1902, p. 242.—ALEXANDER, Psyche, 1911, p. 200.

Male.—Length, 7.6 mm.; wing, 7 mm.; antenna, 8 mm. (about). Head: rostrum and palpi, genæ and occiput, orange-yellow; vertex brown, the anterior portion paler yellowish; front yellow. Antennæ, basal segments, brownish-yellow, segment 3 dark brown, yellowish basally, remaining segments bi-nodose, dark brown.

Thorax: pronotum yellow; mesonotum: præscutum, anterior half bright yellow with a brown spot in the middle at the cephalic end, remainder of the præscutum brown, much darker anteriorly near the pseudosuture; scutum, scutellum and postnotum dark brown; pseudosuture black. Pleuræ: prothoracic, yellow; meso- and metapleuræ dark brownish-black. Halteres light brownish-white. Legs: coxæ and trochanters light yellow; femora light yellow, darkening to form a brown subapical ring, a broad yellow apical band; tarsi yellowish; the posterior pair white.

Wings: brown with a broad pale yellow band across the disk, just distad of the cord and proximad of the fork of M_3 and Cu_1; a pale yellow spot around Rs, and one at end of second A; costal cell and base of wing light yellow; veins brown, yellow where traversed by the yellow markings. Venation: Sc very long, extending far beyond the fork of Rs; cross-vein *r* far back from the tip of R_1 so that R_1 beyond *r* is only a little shorter than R_1 between Sc_2 and *r*; R_{2+3} very short, less than the basal deflection of Cu_1. Cu_1+M_3 much shorter than M_3 alone; basal deflection of Cu_1 beyond the fork of M. (See fig. 3.)

Abdomen: tergum black, extreme tip of segments 2–5 brownish-yellow; remainder entirely black; hypopygium orange-yellow; sternum: segment 2, black; 3, tip orange; 4–6, orange-yellow; 7–8, black.

Igarape Assú, Pará, Brazil, January 23, 1912 (coll. Parish).

Specimen in Cornell University collection.

POLYMERA NIVEITARSIS, new species.

Size, large; flagellum of the antennæ almost simple; posterior tarsi, only, white; basal deflection of R_{4+5} not evident; cell M_1 present.

Male.—Length, 6.2 mm.; wing, 7.3–7.4 mm.; antennæ (about), 12.5 mm. Head: palpi brown; rostrum yellowish brown; antennæ with the two basal segments and the proximal end of the third dull yellow; remainder of the antennæ dark brownish-black, clothed with

Digitized by Google

long black hairs; no distinct constrictions on the flagellum of the antennæ. Front dull yellowish-brown; vertex dark brown; occiput paler.

Thorax: mesonotum dark brown, uniform, dull opaque throughout; pleuræ light grayish-brown. Halteres brown. Legs: coxæ, trochanters, femora, tibiæ and tarsi yellowish-brown; posterior legs with the apical half of tarsal segments 1, and 2, 3, and 4, white.

Wings uniformly tinged with yellowish; veins brown. Venation: Sc long, Sc_1 ending beyond the fork of R_{2+3}; cross-vein *r* far out toward the tip of R_1, so that R_1 beyond *r* is only about one-fifth the distance on R_1 from Sc_2 to *r;* Rs gently arcuated at its origin, in a direct line with R_{4+5}, consequently no basal deflection to R_{4+5} is present; R_{2+3} short, a little longer than the basal deflection of Cu_1; Cu_1+M_3 shorter than M_3 alone; basal deflection of Cu_1 at the fork of M. (See fig. 16.)

Abdomen: tergum dark brown; sternum yellowish; hypopygium brown.

Female.—Length, 5.9 mm.; wing, 7 mm. Flagellum of the antennæ broken; vertex more grayish; oviposter very long and pointed; coloration and venation as in the male.

Paratypes.—Males, specimens 1 and 3 (Surinam) (Brazil). Similar to the type, but the head darker brown with no yellowish tinge. Venation of Surinam specimen: *r–m* at the fork of Rs; basal deflection of Cu_1 at the fork of M. Brazilian specimen: R_1 beyond *r* about one-fourth of the distance on R_1 between Sc_2 and *r;* basal deflection of Cu_1 beyond the fork of M. Specimen 2 (Surinam) is more intermediate between the holotype and paratypes 1 and 3.

Habitat.—Holotype.—Male, Bocas del Toro, Panama, September 28, 1903 (P. Osterhout). In U. S. National Museum collection (No. 14926).

Allotype.—Female, Patulue, Guatemala, Central America (700 feet) (G. Eisen) (received Jan. 6, 1903) (U. S. National Museum collection). *Paratypes 1–2.*—Two males, Surinam (H. Polak) (U. S. National Museum collection). *Paratype 3.*—Male Igarape Assú, Pará, Brazil, January 29, 1912 (Parish), (Cornell University collection).

If the specimen figured by Wiedemann [1] was really a specimen of his *fusca,* then this species is undoubtedly closely allied to *fusca.* It is readily distinguished by its dark brown fore and middle tarsi.

POLYMERA THORACICA, new species.

Size, medium; flagellar segments of the antennæ bi-nodose; wing with cell M present; tarsi white; thorax dark brown, pleural stripe not conspicuous.

Male.—Length, 4.8 mm.; wing, 5.3 mm.; antennæ (about), 7.5 mm. Rostrum and palpi brown; antennæ: basal segment dark brown, segment 2 and the flagellum light brown, the base and tip of the seg-

[1] Auss. Zweifl. Ins., vol. 1, pl. vib, figs. 3, 4.

Digitized by Google

ments light yellow, this annulated effect most noticeable on segments 4–8; a group of wide, outspread hairs extending from each node. Front, vertex and occiput grayish-brown, a black spot in the center of the vertex.

Thorax: dark brown; pseudo-sutural spots, deep, prominent, black; pleurae, brownish-black; the sternum nearly as dark; halteres light brown, the knob darker. Legs: coxæ and trochanters light yellowish, basis of former, brown; femora brown, more yellowish basally, subapically somewhat darker brown; tibiæ brown, tip dark; tarsus, segment 1 light brown, tip whitish; segments 2–4 white; 5 more brownish.

Wings: slightly tinged with gray. Venation: Sc rather long, Sc_1 nearer to the fork of R_{2+3} than fork of Rs; R_1 beyond *r* about one-third the distance of R_1 between Sc_1 and *r*. Basal deflection of R_{4+5} very long, twice as long as *r–m;* M_3+Cu_1 about equal to M_3. Basal deflection of Cu_1 beyond the fork of M. (See fig. 4.)

Abdomen dark brown.

Habitat.—Holotype.—Male, Igarape Assú, Pará, Brazil, February 7, 1912 (Parish).

Type.—In Cornell University collection.

Differs from *albitarsis* Williston in the darker coloration throughout; Sc longer, extending much beyond the fork of Rs; basal deflection of Cu_1 beyond the fork of M, not at it, etc. It comes close to *fusca* Wiedemann, but differs in several details of coloration, and, if Wiedemann's figure represents true *fusca*, as I suppose it does, in venational and antennal characters.

POLYMERA INORNATA, new species.

Size, small; flagellar segments of the antennæ bi-nodose; wing with cell M_1 present; R_1 beyond *r* equal to R_1 between Sc_2 and *r*.

Male.—Length, 4.4 mm.; wing, 4.8 mm.; antenna (about), 6.5 mm. Head: rostrum and palpi light brown; front, vertex, and occiput dark brown, bloom destroyed by mucilage; antennal segments dark brown, somewhat paler at the base and apex of each segment, but not producing an annulated effect.

Thorax: notum light chestnut-brown; pleurae similar but paler, without any distinct darker pleural stripe, sternal region dull yellow. Halteres very pale yellow, the knob light brown. Legs: fore and middle, only, remain; light yellowish-brown, the coxæ and trochanters being more yellow; it is very probable that the posterior tarsi are whitish.

Wings uniformly tinged with yellow; veins brownish-yellow. Venation: Sc long, ending about opposite to the fork of R_{2+3}; cross-vein *r* far removed from the tip of R_1, so that R_1 beyond this cross vein is equal to that section of R_1 between Sc_2 and cross-vein *r*;

Digitized by Google

R_{2+3} short but longer than M_1; basal deflection of R_{4+5} distinct, as long as *r–m;* basal deflection of Cu_1 slightly beyond the fork of M; $Cu_1 + M_3$ about equal to Cu_1 beyond M_3. (See fig. 5.)

Abdomen: tergum, dark brown; sternum, lighter colored.

Habitat.—Holotype.—Male, Tukeit, British Guiana, July 20, 1911 (coll. Lutz).

Type.—In American Museum of Natural History.

Differs from all of the known species in the extreme recession of the cross-vein *r*.

POLYMERA GRISEA, new species.

Size, small; flagellar segments of the antennæ bi-nodose; cell M_1 present; dark pleural stripe narrow, distinct; wings gray.

Male.—Length, 3–3.5 mm. (about); wing, 4.6; antenna, 7.5 (about).

Related to *albitarsis* Williston in its general coloration and venation but very much smaller. In the dark narrow pleural stripe it agrees well with Williston's description.[1] The wings are slightly grayish, not brown; basal segments of the antennæ dark brown; the legs are lacking excepting one of the fore pair. (See fig. 6.)

Habitat.—Holotype.—Male, Ancon, Canal Zone, Panama (A. H. Jennings coll.).

Type.—In U. S. National Museum collection (No. 14937).

Genus EPIPHRAGMA Osten Sacken.

Epiphragma OSTEN SACKEN, Proc. Acad. Nat. Sci. Phila., 1859, p. 238; Monographs, vol. 4, 1869, p. 193; Studies, etc., pt. 2, 1887, p. 208.

This well-defined genus reaches its maximum of species in tropical America. Several of the species that have until now been characterized as "*Limnobia*" are undoubtedly Epiphragmæ and I treat them as such in this paper.

KEY TO THE SPECIES OF EPIPHRAGMA.

1. Wings with complete unicolorous fasciæ, brown or white, extending across the wing.....2.
   Wings with ocellate marks, or pale-margined spots, or incomplete fasciæ.....3.
2. White fasciæ about three; brown fasciæ, as a rule, not connected; tip of tibiæ dark.....*fascipennis* Say[2] (East. U. S.).
   A single white fascia across the middle of the wing, owing to the confluence of the two brown fasciæ on either side; tip of tibiæ light yellow, *imitans*, new species (Bolivia).
3. Ground color of the wing dark brown or rusty-brown.....4.
   Ground color of the wing pale brown, gray, subhyaline or hyaline.....6.
4. Thoracic dorsum velvety black, with a bright yellow, very conspicuous, spot, *histrio* Schiner[3] (Colombia).
   Thoracic dorsum not velvety-black and yellow.....5.

[1] Dipt. St. Vincent, Trans. Ent. Soc. Lond., 1896, pp. 296, 297.
[2] Osten Sacken, Monographs, vol. 4, 1869, p. 194, male and female.
[3] Reise *Novara*, Dipt., 1868, p. 41; male.

Digitized by Google

KEY TO THE SPECIES OF EPIPHRAGMA—continued.

5. Antennal segments 3 and 4, yellow, remainder brown or black; tarsi brown; head black, opaque, yellowish-gray pollinose..*sackeni* Williston [1] (Lesser Antilles).
Antennal segment 3, only, reddish yellow, remainder brown or black; tarsi yellow; head ochraceous brownish-yellow.....*fabricii*, new name (Brazil).
6. Wing markings few, mostly reduced to ocellate or semiocellate markings.....7.
Wing markings ocellate or dark-centered with pale margins; wing margin either abundantly spotted, or with incomplete bands.....8.
7. Mesonotum with a grayish triangle in the middle; sides yellowish-red; legs pale yellow.....*delicatula* Osten Sacken [2] (Colombia).
Mesonotum without gray; pleurae with dark brown stripes; femora with a brown band.....*pupillata*, new species (S. Brazil).
8. Ground-color of the wings hyaline.....*buscki*, new species (Greater Antilles)
Ground-color of the wings not hyaline.....9.
9. Antennæ of male long, reaching to the second abdominal segment.
circinata Osten Sacken [3] (Costa Rica).
Antennæ of male short, reaching to the wing-root.....10.
10. Legs mostly dark brown; femora and tibia with two pale bands; anterior margin of wing with eight larger spots.....*adspersa* Wiedemann (Guiana; Brazil).
Legs mostly yellow; wings without eight larger spots on costal margin.....11.
11. Legs yellow throughout; four large sub-costal spots, the largest at the stigma.
punctulatissima Wiedemann [4] (Brazil).
Legs yellow; femora with a brown band before the tip; wings with an irregular picture.....*solatrix* Osten Sacken [5] (East. U. S.).

Species not included in the above key, because of insufficient description:

Epiphragma varia Wiedemann (Brazil).[6] Wiedemann says:

It must not be confused with *Limnobia maculata* F. (=*fabricii*, n. n.), which it closely resembles, but still in respect to the wing pattern is quite different. Venation as in *L. maculata*. Color of body, brownish all over; of the feet, only one, without tarsi, remaining; this is deep brown, only the tip of the tibia yellow.

Epiphragma nebulosa Bellardi (Mexico).[7]

The description calls for a very large species (male, length, 15 mm.; wing-expanse, 33 mm.); antennæ yellowish throughout, the basal segments paler; mesonotum with a subrotund black spot, fading out behind; halteres brown with the knob black; feet brown, the femora somewhat reddish-brown; feet with three black, equidistant bands, the first in the middle of the femur, the second at the knee; wings that are pale reddish-brown in the middle of the cells, hyaline at the veins.

EPIPHRAGMA IMITANS, new species.

Femora with the apices pale yellow; wings with two complete double fasciæ.

Female.—Length, 11 mm.; wing, 10 mm.; fore leg, femur, 6.5 mm.; tibia, 8 mm.; tarsus, 8.5 mm.; middle leg, femur, 6.4 mm.; tibia, 7.6

[1] Dipt. St. Vincent, Trans. Ent. Soc. Lond., 1896, pp. 294, 295, fig. 68.
[2] Studies on Tipulidæ, vol. 2, 1887, p. 208, male.
[3] Biologia Centrali-Americana, vol. 1, 1886, pp. 9, 10, pl. 1, fig. 1, male.
[4] Auss. Zweifl. Ins., vol. 1, 1828, p. 301.
[5] Monographs, vol. 4, 1869, pp. 195, 196, male and female.
[6] Auss. Zweifl. Ins., vol. 1, 1828, p. 573 (as *Limnobia*).
[7] Ditterologia Messicana, pt. 1, 1859, pp. 206, 207, pl. 1, fig. 4 (as *Tipula*).

Digitized by Google

mm.; hind leg, femur, 7.2 mm.; tibia, 8.5 mm.; head: rostrum and palpi dark brown; antennæ: two basal segments dark brownish-black, third segment bright yellow, fourth darker, brownish-yellow, remainder dark brown; front, vertex, and occiput brown, deeper, more richly colored behind, yellow immediately surrounding the eyes.

Thorax: pronotum brown; mesonotum: præscutum, anterior half deep chestnut-brown, the extreme cephalic margin darker brown, the posterior half with a tawny yellow bloom and with four brown spots; scutum pale yellow on the anterior half, rich brown behind, connected along the lateral edge of the sclerite with the brown of the anterior part of the præscutum; scutellum dark brown; postnotum light brown. Pleuræ pale silvery with four rich brown stripes, the most dorsal of which begins on the dorsum of the pronotum, runs obliquely around to the scutellum, the second, or epipleural, begins on the venter of the pronotum, continues caudad, obliquely, to the postnotum, where it spreads over the sclerite, the third, or episternal, band runs above the coxæ; sternum dark brown, constituting the fourth stripe. Halteres pale yellowish-brown, knob rather darker basally. Legs: coxæ brown medially, paler at the ends; trochanters yellow. Legs all similar to one another in coloration; femora light brownish-yellow with a conspicuous pale yellow apical band; tibiæ pale yellow throughout; tarsi pale yellow, the terminal segments yellowish-orange.

Wings hyaline, with two irregular brown bands across the wing; the proximal one more regular on its outer margin; the distal band has three finger-like projections on its inner margin along Rs, M, and Cu, respectively; the bands are more or less distinctly margined with darker. (See. fig. 35.)

Abdomen: Tergum light brown, the apices of the segments very light yellow, this color continuing back along the lateral edge; a dark brown median line; ninth segment yellow; valves of the ovipositor reddish; sternum pale brown, very pale along the lateral edge.

Habitat.—Holotype.—Female, San Antonio, Bolivia (received from Staudinger and Bang-Haas, Germany).

Type.—In author's collection.

EPIPHRAGMA FABRICII, new name.

Tipula maculata Fabricius, Syst. Antl., 1805, p. 30 (not T. *maculata* Linnæus nor T. *maculata* Meigen) (1804).

Limnobia maculata Wiedemann, Dipt. Exot., vol. 1, 1821, p. 16; Auss. Zweifl. Ins., vol. 1, 1828, p. 29.—Hunter, Trans. Amer. Ent. Soc., vol. 26, 1900, p. 289.—Kertesz, Catalogus Dipteroum, vol. 2, 1902, p. 174.

Male.—Length, 10–11.5 mm; wing, 14 mm.

Head: rostrum light brown, palpi blackish-brown; clypeal region and anterior portion of the front to just behind the origin of the

Digitized by Google

antennæ dark colored; antennæ: segment one dark, blackish, covered with a thick light-colored pubescence, second segment dark brown, third segment conspicuously orange-red, remainder dark brownish-black. Front (behind), vertex and occiput dull tawny-yellow, darker behind and underneath on the genæ; a conspicuous brown line on the head, anteriorly enlarged into a conspicuous spot running back toward the collare. Front nearly as wide as the first antennal segment is long.

Thorax: pronotum dark brown; mesonotum, rich reddish-brown, in front a narrow dark brown margin which continues back toward the lateral margins of the sclerite; medially a narrow brown line runs back for a short distance, but fades out at about one-third the length of the sclerite; scutum brown, darker caudally. On the lateral margins of these two sclerites (scutum and præscutum) is a large buff spot, hemmed in above by a fuscous line running cephalad from the suture for one-third the length of the præscutum and then bent strongly laterad and recurved, to form a deep chocolate-brown spot occupying the lateral margins of both sclerites. Scutellum and postnotum dusky brownish-black, paler at the sutures; metanotum brownish-black. Pleuræ and sterna very dark brown, almost uniform except a darker black band which begins on the prosternum and continues back across the epipleuræ. Halteres yellowish, a little darker toward the knob. Legs: coxæ and trochanters brown, slightly paler toward the tips (rest of legs gone, but probably with more or less dark color).

Wings light yellow with about eight brown spots along the anterior margin of the wing, of which the second is located on the cross-vein *h;* fourth and sixth larger, at base of Rs and tip of Sc; irregular light brown bands lead from these spots across the wing, each spot and band being separated from the ground-color of the wing by a subhyaline margin. First anal cell with three subequal brown marks at its tip, second anal cell with about five at its tip. (Venation as in fig. 33.)

Abdomen: tergum dark brown, apices of segments more or less paler; sterna paler, more yellowish-brown, especially on the caudal margins of the segments; hypopygium light yellowish-brown beneath.

A second specimen has the rostrum reddish-brown; the third antennal segment still more conspicuous, orange; the lateral marks on the mesothoracic præscutum and scutum much paler brown; pleuræ paler brown.

Two specimens (males) from Chapada, Matto Grosso, Brazil (Coll. H. H. Smith).

In American Museum of Natural History.

Digitized by Google

EPIPHRAGMA PUPILLATA, new species.

Pale yellow; a narrow brown median line on head; thoracic pleuræ with broad brown bands; fore femora with a pale brown subapical band; wings subhyaline with about nine darker spots along the costal margin and a few pale brown spots over the rest of the wing; an ocellate mark at the origin of the sector.

Male.—Length, 7 mm.; wing, 9–9.5 mm.; fore leg, femora, 6 mm.; tibia, 7.25 mm.; head: rostrum and palpi brown; antennæ yellow; first segment elongate-cylindrical, second rounded-oval, remainder lacking; front, vertex and occiput light yellow, somewhat darker posteriorly with a rather narrow dark brown median line beginning at the narrowest portion of the front, continued caudad; front narrow, about three-fourths of the first antennal segment

Thorax: pronotum, yellow, brownish medially, with three dark brown rounded spots, the median one in front on the scutum, the lateral ones larger on sides of the scutellum. Mesonotum: præscutum, pale brownish-yellow, the lateral and cephalic margins of the sclerite broadly brown, continuing back to the wing-bases, a similarly colored, very narrow median line begins at the cephalic margin of the præscutum, continues backward with more or less distinctness to the suture; scutum yellowish, brownish medially, this color broadened out on the caudal margin; scutellum pale yellow; post-notum, brownish-yellow. Metanotum darker, brown. Pleuræ: a narrow oblique brown band running from the collare caudad to the wing bases, inclosing the mesothoracic stigma, bounded on either side by a very narrow pale line; remainder of pleuræ and sterna dark brown. Halteres light yellow, the apical half of the stem and base of the knob slightly infuscated. Legs: coxæ yellow, brown basally; fore leg, only, remains; femur light yellow with a pale brown subapical band; tibia light yellow throughout; tarsi lacking.

Wings (see fig. 37) subhyaline, nine brown spots along the anterior margin, the second being at the humeral cross-vein, fourth over the origin of R_5, fifth, at the supernumerary cross-vein, sixth, at the tip of Sc_1, seventh, at tip of R_1, eighth and ninth, at tips of R_2 and R_3, respectively. A distinct eye-like spot, its pupil at the angulation of R_5, pale brown. Three dark brown spots in cell Sc, under the third to fifth costal spots described above. Other pale brown marks on the wing disk, as follows: semicircular extending from the third costal spot backward across the base of cells R and M; a row of seven in cell second anal; one at tip of vein second anal; two at the end of cell first anal; four in the distal half of cell Cu; one at end of cell M, in cell Cu and in cell M_2; two in cell M_3, two or three in cell R_5; a large one about the stigma, extending down into cells first R_1, R_2, and base of R_3; a semicircular one in cells first R_1 and end of R_1 crossing the end of the sector; this last, with the stigmal spot, forms

Digitized by Google

an incomplete ocellus in this region of the wing. Venation (see fig. 37).

Abdomen: terga dark brown on segments 1 to 4; segments 5 to 8 paler brown; sterna, first dark brown, remainder paler brown; hypopygium pale yellow.

The paratype differs as follows:

Similar to the type, but shows the pleural markings better. The brown stripe inclosing the anterior stigma is here pale in front but darker near the wing-bases, and surrounded by the pale lines described above. Below this is a broad dark brown stripe, beginning on the ventral side of the pronotum, separating at the fore coxæ and continuing back across the epipleuræ as a broad, deep chocolate-brown band which becomes more indistinct in the vicinity of the metapleuræ. Ventrad of this band on the lateral margins of the mesosterne is a pale silvery bloom, with a dark brown spot above almost continuous with the epipleural band and below changing to the dusky brown of the venter.

Wings about as in the holotype, but three spots in the end of cell first anal and a few of the other spots encroaching into various cells of the wing, but the size of these spots seems to be only relative and the number is generally probably as given in the type description.

Habitat.—*Holotype.*—Male, Chapada, Matto Grosso, Brazil (H. H. Smith, coll.). *Paratype.*—Male, same locality and collector.

Type.—In American Museum of Natural History.

EPIPHRAGMA BUSCKI, new species.

Related to *E. solatrix* and *E. sackeni*; differs from both species in its different wing-picture; from *solatrix* in leg-coloration, etc.

Male.—Length, 8 mm.; wing, 8.2 mm.; head: rostrum yellow; palpi dark brown; antennæ with the two basal segments dark brownish-black; remainder broken; vertex and occiput brownish-gray, clearer gray nearest the eyes; a brown mark connecting the eyes back of the front; front gray; cervical sclerites and genæ blackish.

Thorax: pronotum dark brown, the scutellum lighter; mesonotum: præscutum anteriorly light brown with five narrow brown lines running from the cephalic margin backward, the median one is broadest in front and continues farthest caudad; caudal margin of the sclerite with a thick whitish-yellow bloom, in front of which is a dark brown band extending from the ends of the transverse suture across the sclerite; the space between the lateral stripes is filled with brown, giving the appearance of but three longitudinal stripes of which the lateral ones are broad; scutum light yellow with an indistinct brown transverse band; scutellum brown caudally; postnotum light ochraceous-yellow with a brown base and tip; metanotum light yellow. Pleuræ light silky yellow, with an interrupted dark brown band extending from near the caudal margin of the pronotum back across

Digitized by Google

the epipleuræ to the base of the abdomen. Halteres long, slender, stem yellow, knob brown with the extreme margin paler. Legs: coxæ and trochanters dull yellow; middle coxa with a broad triangular black mark on its caudal aspect; posterior coxæ dark brownish. Hind leg only remains; femora brown except the base, a post-medial and a sub-apical band, yellow; tibiæ dark brown; tarsi light yellowish-brown.

Wings clear hyaline with an irregular brown picture; the brown markings not edged with lighter as in *sackeni*, and no tawny as in *solatrix*. Venation (see fig. 36).

Abdomen: first segment light yellow; tergites dark brown, the basal half clearer, darker brown, the apical half more indistinct; hypopygium dull yellow; sternites light yellow.

Habitat.—Holotype.—Male, San Francisco Mountains, Santo Domingo, West Indies, Sept., 1905 (Aug. Busck, coll.).

Type.—In U. S. National Museum collection (No. 14938).

EPIPHRAGMA ADSPERSA Wiedemann.

Limnobia adspersa WIEDEMANN, Auss. Zweifl. Inskt., vol. 1, 1828, p. 550—HUNTER, Trans. Amer. Ent. Soc., vol. 26, 1900, p. 288.—KERTESZ, Cat. Dipt., vol. 2, 1902, p. 169.

Length, male, 8.25 mm.; wing, 10.2 mm.

Head: rostrum and palpi brown; antennæ: first segment dark brown with a gray bloom, second dark, brownish-black, third light yellow, fourth pale brownish-yellow, remainder dark brownish-black. Front rather broad, tawny yellow, a median brown line only on the occiput and caudal end of the vertex.

Thorax: pronotum, yellow with an indistinct darker median line, enlarged behind; mesonotum yellow anteriorly, the sclerite is narrowly brownish, with a very narrow brown line running backward toward the suture; on the sides of the præscutum the brown is broader and clearer except anteriorly, where it is paler; scutum with a depressed area at the point of the suture; scutum, scutellum, postnotum and meta-notum dull yellowish-brown. Pleuræ pale brown with the usual dusky epipleural stripe leading from the prosternum backward, and the dusky color on the venter. Halteres long, pale brown, knob not conspicuously brighter. Legs: middle pair; coxæ pale, whitish; trochanters brown; femora dark brown, a narrow yellow band beyond the middle and a broader one at the tip; tibia, base broadly yellow, middle tip of tibia yellow; tarsi conspicuously light yellow, the last segment more brown. Hind legs: coxæ pale; trochanters brown; femora dark, the band beyond the middle broader than in the middle pair, tip of femora and base of tibia with subequal bands of pale yellow; tibia almost all light yellow with a broad brown subapical band; tarsi, basal two-thirds of the metatarsus pale yellow, rest of the tarsi dark brown.

Digitized by Google

Wings: hyaline or nearly so; anterior margin with about eight large brown spots along the margin, the fifth being at the tip of Sc; between the large spots are scattered smaller dots. The whole disk of the wing is covered with pale greyish-brown spots distributed as in the figure. Venation as in fig. 34.

Abdomen: tergum brown; sterna brown; apices of segments paler; hypopygium dark brown.

One male from "Forest, British Guiana; Aug. 5, 1911 (Crampton coll.). Specimen in the American Museum of Natural History.

Genus CTEDONIA Philippi.

Ctedonia PHILIPPI, Verh. Zoöl-bot. Ges. Wien, vol. 15, 1865, p. 602.—OSTEN SACKEN, Monographs, vol. 4, 1869, p. 334; Studies on Tipulidæ, pt. 2, 1887, p. 213.

The following description is translated from Philippi's original characterization of the genus [1] by Osten Sacken. I have adopted this translation [2] almost as it stands:

Head small, globose, attenuated behind, produced anteriorly into a stout horizontal rostrum. Eyes globose, rather remote. No ocelli. The antennæ in length are equal to about three-quarters of the head and the thorax taken together; from 15 to 24 segmented; first segment cylindrical, stout; the second equal to one-third of the first, subglobular; the following eight (to 12), cylindrical, subequal, emitting a filament and thus forming a comb; the projection of the third segment is on the external side and short; the fourth segment has one on the inside and another on the outside; the segments 5, 6, 7, 8, 9, 10 and beyond, have on the inside a long projection; segment 11 has a short one on the inside; the nine following segments are cylindrical and difficult to distinguish. Palpi 4-segmented, segments cylindrical, the fourth stout, rather short, although a little longer than the third. The tibiæ have two spurs at the tip.

The genus was not represented in any of the material that I received for examination.

KEY TO THE SPECIES OF CTEDONIA.

1. Antennæ with only 15 segments; wings hyaline with two black spots, the large one extending from cell first M_2 to the stigma..*bipunctulata* [3] Philippi (Chile).
   Antennæ with 22 or more segments.....2.
2. Wings almost unicolorous.....3.
   Wings with brown clouds, on a limpid ground.....*pictipennis* [4] Philippi (Chile).
3. Body gray; head blackish; wings yellowish with a pale brown stigmal spot; feet yellowish, the tip of the fore femur with a brown band; antennæ with 22 segments.....*flavipennis* [5] Philippi (Chile).
   Body yellow except the head, antennæ, palpi, sternum of thorax including the coxæ; tip of abdomen; tibiæ and tarsi, which are black; wings somewhat yellowish-brown; femora luteus; antennæ with 24 segments.
   bicolor [6] Philippi (Chile).

[1] Verh. Zoöl-Bot. Ges. Wien, vol. 15, 1865, p. 602.
[2] Monographs, vol. 4, p. 334.
[3] Verh. Zoöl-Bot. Ges. Wien, 1865, p. 603, male and female (?).
[4] Idem, p. 603, female.
[5] Idem, pp. 602, 603, female.
[6] Idem, p. 603, male.

Digitized by Google

I have not included *C. fusca* Jaenn., as it is probably synonymous with *flavipennis*, above.

Genus LIMNOPHILA Macquart.

Limnophila MACQUART, Hist. Nat. Dipt., Suite à Buffon, vol. 1, 1834, p. 95.—OSTEN SACKEN, Monographs, vol. 4, 1869, pp. 196–202.
Phylidorea BIGOT, Ann. Soc. Ent. France, 1854, p. 456.
Limnomya RONDANI, Prodromus Dipt. Italicæ, vol. 4, 1861, p. 11.
Pilaria SINTENIS, Sitzgsber. Naturf. Ges. Dorpat, vol. 8, 1888, p. 398.

The subgenera of the genus LIMNOPHILA Macquart.

Idioptera MACQUART, Hist. Nat. Dipt., Suite à Buffon, vol. 1, 1834, p. 94.
Limnophila MACQUART, Hist. Nat. Dipt., Suite à Buffon, vol. 1, 1834, p. 95.
Lasiomastix OSTEN SACKEN, Proc. Acad. Nat. Sci. Phila., 1859, p. 233.
Prionolabis OSTEN SACKEN, Proc. Acad. Nat. Sci. Phila., 1859, p. 239.
Dicranophragma OSTEN SACKEN, Proc. Acad. Nat. Sci. Phila., 1859, p. 240.
Dactylolabis OSTEN SACKEN, Proc. Acad. Nat. Sci. Phila., 1859, p. 240.
Ephelia SCHINER, Wien. Ent. Monatschr., vol. 7, 1863, p. 222.
Poecilostola SCHINER, Wien. Ent. Monatschr., vol. 7, 1863, p. 222.
Rhicnoptila NOWICKY, Verh. Zoöl-bot. Ges. Wien, vol. 17, 1867, p. 337.
Eutonia v. d. WULP, Tijdschr. voor Entomol, vol. 17, 1874, p. 147.

I have refrained from giving a key to the included forms because the numerous species described by Blanchard and Philippi are almost certainly a mixture of several genera, and until more of these species are rediscovered it would be foolhardy to attempt a key in this group.

I am including in *Limnophila* the species described as *Polymoria* Philippi. The only species I have ever seen, *P. lutea*, is represented by a single legless specimen, and I am unable to decide as to whether or not this insect has spurred tibiæ.

LIMNOPHILA EPIPHRAGMOIDES, new species.

Light brown and yellow; halteres extremely long; wings hyaline, with a brown picture. Venation: Petiole of cell M_1 very short; basal deflection of Cu_1 far before the fork of M.

Female.—Length, 12.4 mm.; wing, 10.6 mm.; abdomen, 10 mm.; halteres, 2.3 mm. Legs: fore, femora, 7.1 mm.; tibia and tarsus gone; middle, femora, 7.1 mm.; tibia and tarsus gone; hind, femora, 8.2 mm.; tibia, 10 mm.; tarsus, 8.7 mm.

Alcoholic specimen—Head: rostrum and palpi brownish-yellow; antennæ, first segment elongated, cylindrical, brown, second oval, yellow; flagellum broken. Eyes oval, large; front and vertex very narrow between the eyes, yellowish-brown.

Thorax: brown; stripes on the mesothoracic præscutum ill-defined; the post-notum rather more yellow. Pleuræ light yellow, a brown linear mark above the base of the halteres and a small brown spot above the base of each coxa. Halteres extremely long, much longer than the thorax, stem yellow, the knob brown, clothed with fine papillæ. Legs: coxæ yellow, apically with a narrow ring of brown;

Digitized by Google

femora yellow, gradually darker, more brownish, toward the tip of the segment; remainder of the legs light yellow.

Wings hyaline; cells C, Sc, Sc_1, first R_1, second R_1, R_2 and the anterior border of R light brown; a light yellow spot near the distal end of cells C and Sc; a clear yellow spot on the basal third of cell Sc_1, at end of cells second R_1 and R_2; a dark brown suffusion at the end of veins Sc and Sc_2, R_2, R_3 and a very large one at the end of R_1. Remainder of the wing with light brown markings as follows: along the cord, in cell R_3, excepting three hyaline spots at the base, at the first quarter, and a rectangular spot at the middle, cell R_5, apex and middle brown; a brown cloud along the cross-vein *m* and second deflection of M_3, a continuation of the medial band in cell R_5; brown marks in base and apex of cell M_1, apex of cell second M_3; apex and middle of M_3; a large cloud at the end of Cu_2 and first A; around the basal deflection of Cu_1, at the fork of R_5, and two eye-like spots in the middle of cell Cu and above the end of second anal. Venation: Sc rather long, extending to opposite the fork of R_{2+3}; Sc_2 at the tip of Sc_1; *r* far removed from the tip of R_1; R_{2+3} short, rather longer than the basal deflection of Cu_1; basal deflection of R_{4+5} arcuated, nearer the base of the wing than the rest of the cord; M_{1+2} beyond *m* (i. e., petiole of cell M_1) very short, shorter than the cross-vein *r;* basal deflection of Cu_1 far anterior to the fork of M, the distance that M is fused with Cu_1 greater than the deflection of Cu_1 alone. (See fig. 40.)

Abdomen: tergum brown, bases and apices of segments yellow; a narrow, transverse, yellow band near the middle of each segment interrupted medially, forming two rectangular spots; on segments 5–8 the yellow bases to the segments are not evident, but are replaced by small, square or rounded dots at the latero-cephalic margin of the sclerites; ovipositor with short yellowish valves; sternum, yellow, with a broad, brown subbasal blotch on each sclerite, triangular on its anterior margin.

Habitat.—Holotype.—Female, Igarape Assú, Pará, Brazil; January 30, 1912 (Parish, coll.).

Type.—In Cornell University collection.

LIMNOPHILA NACREA, new species.

Color, silvery gray, antennæ white, excepting segments 1, 2, and 16, which are dark.

Female.—Length, 8.2 mm.; wing, 8.4 mm. Head: rostrum and palpi dark brown; antennæ: first segment short, cylindrical, second of the same diameter, short, flagellar segments elongate, gradually shorter to the end, with a few long hairs on the basal half of each segment, each segment being covered with a dense pubescence, two scapal segments dark brown, third segment brownish at base,

Digitized by Google

whitish-yellow apically, remaining segments, except the last, white, ultimate segment black. Front rather broad; head triangular behind; eyes conical, with coarse ommatidia; front, vertex, and occiput light silvery gray.

Thorax: pronotum white; mesonotum: præscutum pearl gray, whitish along the lateral margin; no evidence of a pseudo sutural pit or fovea; scutum gray, yellower caudad; post-notum dull gray. Pleuræ light brownish-yellow, the sternum clear light yellow. Halteres long, slender, light brown. Legs long, slender; coxæ light yellow; remainder of the legs light brownish-yellow, the apical segments darker.

Wings pearly white; stigma pale brown; veins light brownish-yellow. Venation: Sc long, Sc_1 ending about opposite to the fork of the sector; Sc_2 near its tip; R_1 long, rather close to R_2. R_5 short, gently arcuated; R_{2+3} gently arcuated, short, equal to R_2; R_2 short, oblique; R_3 long, feebly sinuated. M_{1+2} fused to the wing margin; cross-vein *m* obliterated; fusion of Cu_1 with M_3 about equal to M_3 before the basal deflection of Cu_1, both shorter than the deflection; second anal long, gently sinuated. (See fig. 19.)

Abdomen brown, the ovipositor yellow.

Habitat.—Holotype.—Female, Cinchona, Jamaica, West Indies, Feb. 24, 1911.

Type.—In American Museum of Natural History.

The open cell first M_2 may be an abnormality of the specimen; if not, the insect may be the representative of a new subgenus.

LIMNOPHILA LENTOIDES, new species.

Male.—Length, 5.2–5.4 mm; wing, 6.9–7 mm. Head: Rostrum and palpi brown; antennæ: basal segment elongate-cylindrical, second globular, cyathiform, dull yellow; flagellar segments rather regularly oval, clothed with a fine pubescence, dark brownish-black. Front and anterior portion of the vertex gray; caudal portion of the vertex, and the occiput, gradually darker brown.

Thorax: pronotum distinct, brown with a grey bloom. Mesonotum brown with a yellowish-grey bloom; pseudosutural pit on the præscutum, small, semilunate, black. Pleuræ light gray. Halteres long, light brown. Legs: coxæ and trochanters llight yelow; femora yellowish-brown; tibiæ and tarsi light brown.

Wings subhyaline, with brownish-yellow veins. (See fig. 21.)

Abdomen: tergites brown; sternites dull yellow.

Female.—The female is larger and has the wings strongly tinged with yellow (length, 8.8 mm.; wing. 8.8 mm.). This specimen lacks a cell first M_2 in both wings.

Paratype No. 1 is like the type, but the mesothoracic præscutum shows four indistinct brown stripes, two long, narrow ones on either

Digitized by Google

side of the median line, and a broader one extending from behind the pseudosuture back to the transverse suture. The venation seems to be almost as variable as in the northern *L. lenta* Osten Sacken.

Habitat.—*Holotype.*—Male, Totonicipan, Guatemala, Central American, 1902 (G. Eisen). *Allotype.*—Female with the type. *Paratypes.*—Three males with the type.

Type.—In U. S. National Museum collection (No. 14939).

LIMNOPHILA CINERACEA Philippi.

Limnophila cineracea PHILIPPI, Verh. Zool. Bot. Ges. Wien., vol. 15, 1865, p. 611.—HUNTER, Trans. Amer. Ent. Soc., vol. 26, 1900, p. 292.—KERTESZ, Cat. Dipt., vol. 2, 1902, p. 228.

Male.—Length, 6.5 mm.; wing, 7.6 mm.

Head: rostrum black; antennæ short, the segments rounded or subglobular, black; front, vertex and occiput brown with a light gray bloom; numerous long, scattered hairs behind the eyes.

Thorax: pronotum: scutum gray, strongly suffused with brown in the middle; scutellum gray, more brownish on the lateral margins; mesonotum: præscutum pale brown with a light gray bloom, a more or less distinct brown stripe along the middle, extending from the transverse suture almost to the cephalic margin of the sclerite; pseudo-suture black, comma-shaped; tuberculate pits not visible; scutum, scutellum and post-notum black, dusted with light grey; pleuræ dark, dusted uniformly with light gray. Halteres pale throughout. Legs: coxæ gray; trochanters yellowish-brown; femora brown, more yellowish basally; tibiæ and tarsi brown.

Wings whitish, subhyaline; veins brown; a very pale, ill-defined, brown stigma. Venation: Sc. long, extending almost to the fork of Rs.; cross vein *r–m* very strongly arcuated, U-shaped; cell first M_2 long and narrow; deflection of M_3 longer than the cross vein *m*; basal deflection of Cu_1 in under cell first M_2.

Abdomen: tergum brown; lateral margins of the sclerites paler, yellowish; hypopygium reddish brown.

"Chile," E. C. Reed, coll.

Specimen in U. S. National Museum collection.

The species belongs to the *lenta* group of the genus, in which cell M_1 is entirely lacking.

LIMNOPHILA GUTTULATISSIMA, new species.

Light brown, the thorax with darker spots; legs yellow; wings subhyaline, with abundant brown dots.

Male.—Length, 8.2 mm.; wing, 10 mm.; hind leg, femur, 7.5 mm.; tibia, 8.4 mm.; tarsus, 6.6 mm.

Head: rostrum and palpi dark brownish-black; antennæ, basal segment black, remainder broken. Front and vertex gray with a

Digitized by Google

triangular black mark between the eyes and a brown margin on the inside of the eye; vertex thickly dotted with brown; occiput gray.

Thorax: pronotum gray; mesonotum: præscutum, pale brown with a grayish bloom in front, with indistinct darker brown spots on the caudal half of the sclerite; scutum, light brownish-yellow, with a large rounded dark brown spot on either side of the median line and a smaller lateral spot which is continued cephalad upon the caudal portion of the præscutum; scutellum gray, suffused with brown anteriorly, a blackish edging along the caudal margin; post-notum grey. Pleuræ brown, with a decided gray bloom. Halteres light yellow. Legs: anterior: coxæ and trochanters light yellow, remainder broken; middle and hind: coxæ and trochanters brownish-yellow; femora yellowish-brown; tibiæ and tarsi similar, the three apical tarsal segments brown.

Wings: subhyaline, veins yellow, especially in the cephalic portion of the wing; all the cells with numerous fine dots of light brown, these dots assuming a reticulated appearance in the caudal cells, confluent, forming large brown blotches about the base of Rs, along the cord and running cephalad over the fork of R_{2+3}, and the apical portions of cells second R_1, R_2, and R_3. Venation (see fig. 38, from which the wing pattern has been omitted): Sc rather short, ending just beyond the fork of R_{2+3}; Sc_2 at the tip of Sc_1, slightly longer than Sc_1; Sc_1 remote from the tip of R_1. Rs long, arcuated at its origin; R_{2+3} short; R_2 strongly arcuated at its origin; *r* far back from the tip of R_1; M_{1+2} beyond *m* longer than either M_1 or M_2, which are subequal. Basal deflection of Cu_1 in under the middle of cell first M_2.

Abdomen: tergum brown, the lateral margins of the sclerites yellow; hypopygium reddish-yellow; sternum yellow, the sixth and seventh segments more brownish.

Habitat.—*Holotype.*—Male, Totonicipan, Guatemala, Central America (Eisen, coll.).

Type.—In U. S. National Museum collection (No. 14940).

? LIMNOPHILA LUTEA Philippi.

Polymoria lutea PHILIPPI, Verh. Zoöl-bot. Ges. Wien, vol. 15, 1865, p. 609.—HUNTER, Trans. Amer. Ent. Soc., vol. 26, 1900, p. 290.—KERTESZ, Cat. Dipt., vol. 2, 1902, p. 198.

Male.—Length, 10.7 mm; wing, 12–12.2 mm.

Head: rostrum and palpi dark brown; antennæ brown, the flagellar segments rather brighter; front, vertex and occiput dark brown.

Thorax: præscutum reddish-yellow with indistinct reddish stripes on either side of the middle line; scutum deep brownish-red; scutellum reddish-yellow; postnotum brown; pleuræ brown, the proleuræ lighter, yellowish. Halteres, stem and knob light yellow.

Digitized by Google

Legs: coxæ and trochanters yellow, the former obscured; remainder of legs gone.

Wings strongly tinged with yellow; costal cell light yellowish-brown; extreme base of cell second R_1 and tip of cell first R_1 brown; a rounded white mark in cell first R_1 just above the fork of R_{2+3}; most of cell second R_1 white; tips of cells R_2 and R_3 very pale, subhyaline; veins yellow, C, Sc and R more brownish. Venation: Rs very long, almost straight at its origin and about in a line with R_{2+3} and R_2; R_{2+3} very short, shorter than the cross vein *r–m;* R_2 strongly arcuated at its origin; M_{1+2} beyond cross vein *m* shorter than either M_1 or M_2 alone; basal deflection of Cu_1 beyond the middle of cell first M_2; second anal elongate sinuated.

Abdomen: tergum light yellow, especially along the lateral margins of the sclerites; along the mid-dorsal line, darker, brown. Hypopygium reddish-yellow. The genitalia suggest *L. adusta* Osten Sacken and its allies, and also *Polymera*, consisting of elongate, cylindrical pleural pieces set with long pale hairs and bearing apically appendages which are dark colored, chitinized and denticulate on their outer face.

"Chile" (E. C. Reed, coll.).

Specimen in U. S. National Museum collection.

EXPLANATION OF THE PLATES.

PLATE 65.

Fig. 1. Hypopygium of *Polymera obscura.*
2. Wing of *Polymera superba.*
3. Wing of *Polymera hirticornis.*
4. Wing of *Polymera thoracica.*
5. Wing of *Polymera inornata.*
6. Wing of *Polymera grisea.*
7. Wing of *Polymera conjuncta.*
8. Wing of *Cryptolabis tropicalis.*
9. Wing of *Sacandaga parva.*
10. Wing of *Mongoma longifusa.*
11. Wing of *Mongoma extensa.*
12. Wing of *Molophilus thaumastopodus.*
13. Wing of *Mongoma niveitarsis.*

PLATE 66.

Fig. 14. Wing of *Gonomyia puer.*
15. Wing of *Gonomyia unicolor.*
16. Wing of *Polymera niveitarsis.*
17. Wing of *Polymera pleuralis.*
18. Wing of *Polymera obscura.*
19. Wing of *Limnophila nacrea.*
20. Wing of *Erioptera immaculata.*
21. Wing of *Limnophila lentoides.*
22. Wing of *Mongoma disjuncta.*
23. Wing of *Gnophomyia subhyalina.*

Digitized by Google

PLATE 67.

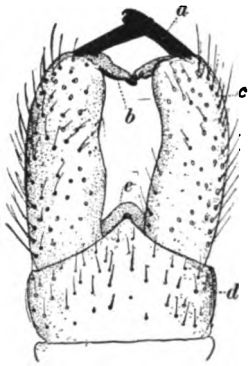
Fig. 24. Wing of *Erioptera costalis*.
25. Wing of *Erioptera knabi*.
26. Wing of *Erioptera eiseni*.
27. Wing of *Erioptera parva brasiliensis*.
28. Wing of *Erioptera splendida* (vein *sc*. accidentally omitted).
29. Wing of *Gnophomyia luctuosa*.
30. Wing of *Gnophomyia hirsuta*.
31. Wing of *Gnophomyia magnifica*.
32. Wing of *Gnophomyia rufithorax*.

PLATE 68.

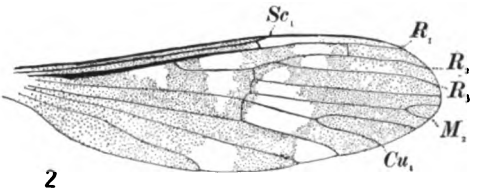
Fig. 33. Wing of *Epiphragma fabricii*.
34. Wing of *Epiphragma adspersa*.
35. Wing of *Epiphragma imitans*.
36. Wing of *Epiphragma buscki*.
37. Wing of *Epiphragma pupillata*.
38. Wing of *Limnophila guttulatissima* (pattern omitted).
39. Wing of *Lecteria matto-grossæ*.
40. Wing of *Limnophila epiphragmoides*.
41. Wing of *Lecteria obliterata*.
42. Wing of *Lecteria armillaris*.

Digitized by Google

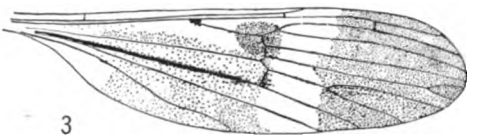
Digitized by Google



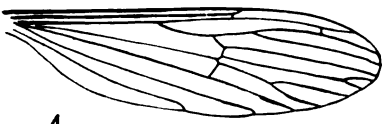
1



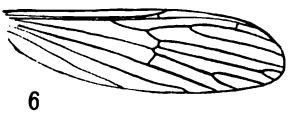
2



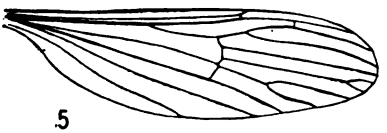
3



4

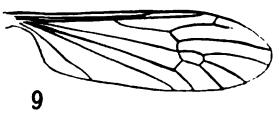


6

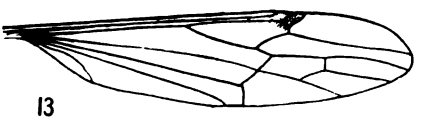


5

7



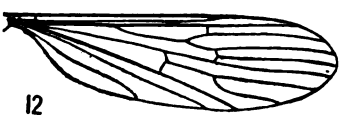
9



13

11

8



12

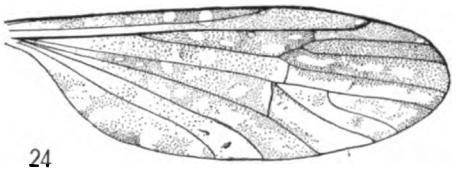
10

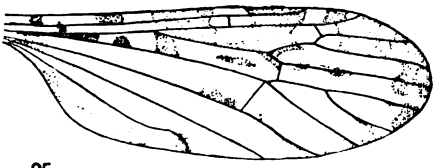
VENATION OF NEOTROPICAL CRANE FLIES.

FOR EXPLANATION OF PLATE SEE PAGE 548.

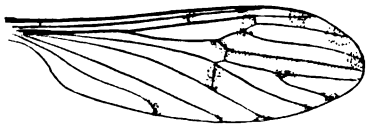
Digitized by Google

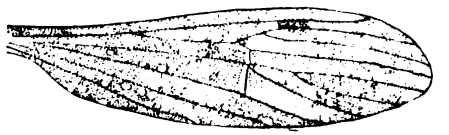
Digitized by Google

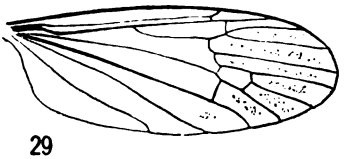

24

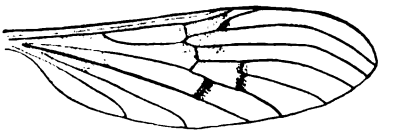

25

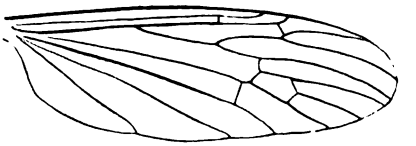
26

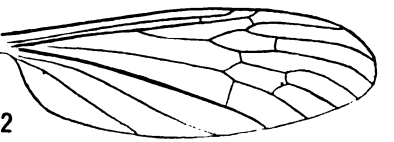

27


28


29


30


31

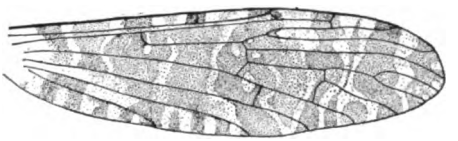

32

VENATION OF NEOTROPICAL CRANE FLIES.

FOR EXPLANATION OF PLATE SEE PAGE 549.

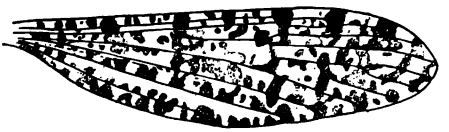
Digitized by Google

Digitized by Google

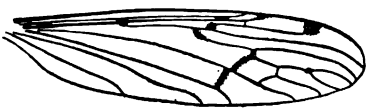


33

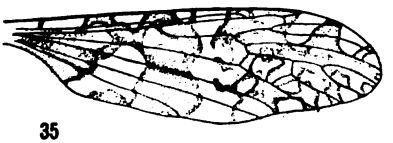
38



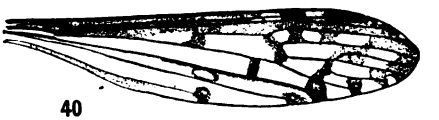
34



39

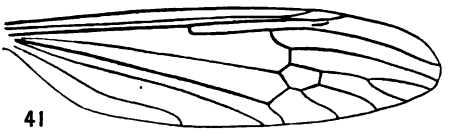


35



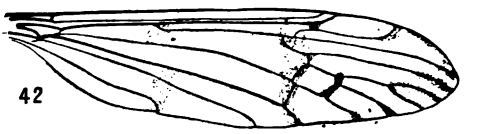
40

36



41

37



42

VENATION OF NEOTROPICAL CRANE FLIES.

FOR EXPLANATION OF PLATE SEE PAGE 549.

Digitized by Google

Digitized by Google

DESCRIPTION OF A NEW SPECIES OF ACTINIAN OF THE GENUS EDWARDSIELLA FROM SOUTHERN CALIFORNIA.

By J. PLAYFAIR MCMURRICH,
Of the University of Toronto, Canada.

The only species belonging to the family Edwardsiidæ hitherto described from the west coast is that from Unalaska which Torrey [1] has identified with the *Edwardsia sipunculoides* of Stimpson.

The present form differs markedly from this and is sufficiently different from other known members of the family to warrant its recognition as a distinct species, for which I propose the name *Edwardsiella californica*. It may be identical with a form from San Pedro mentioned, but not described nor named, by Torrey in the paper just referred to.

EDWARDSIELLA CALIFORNICA, new species.

Anaheim Bay (Creek), California: Muddy shore, about one mile inland, at or below low water, one example; mud flats and shore at, or below, low tide, "Stingaree Hole," six examples.

Type.—Cat. No. 30716, U.S.N.M.

All the examples were completely contracted so that both the capitulum and tentacles were concealed. The scapus was covered by the brown furfuraceous epidermis, characteristic of Edwardsians, and was grooved longitudinally by eight rather deep invections, marking off a similar number of broad longitudinal ridges. These latter bore large and usually prominent nematocyst capsules, which were arranged in a single row on the distal part of the scapus, but more proximally were in two or three closely adjacent rows, so that it seems proper to refer the species to the genus *Edwardsiella*. The physa was large and smooth; it lacked the epidermis present on the scapus, but had numerous minute particles of sand adhering to it.

Color.—In examples preserved in formalin the scapus was of a dark chestnut-brown color, due to the epidermis, and the physa was clear and transparent.

Size.—Height of column in contracted examples 2.8 cm.; diameter of column 0.4 cm.; length of physa about 0.3 cm.

[1] H. B. Torrey. Anemones (of the Harriman Expedition) with discussion of variation in Metridium. Proc. Washington Acad. Sci., vol. 4, 1902, p. 378.

Digitized by Google

Structure.—A series of transverse sections showed that the number of tentacles was 16, and that they were arranged in the typical manner with reference to the perfect mesenteries, namely, one over each directive chamber, three over each sulculolateral chamber, and two over each of the other chambers. It also possesses the typical arrangement of the mesenteries, there being in addition to the eight protocnemes a pair of rudimentary mesenteries in each protocnemic sulculolateral chamber and a single one in each lateral and sulco-lateral chamber. As is usual in the Edwardsiidæ these rudimentary mesenteries are confined to the uppermost part of the column.

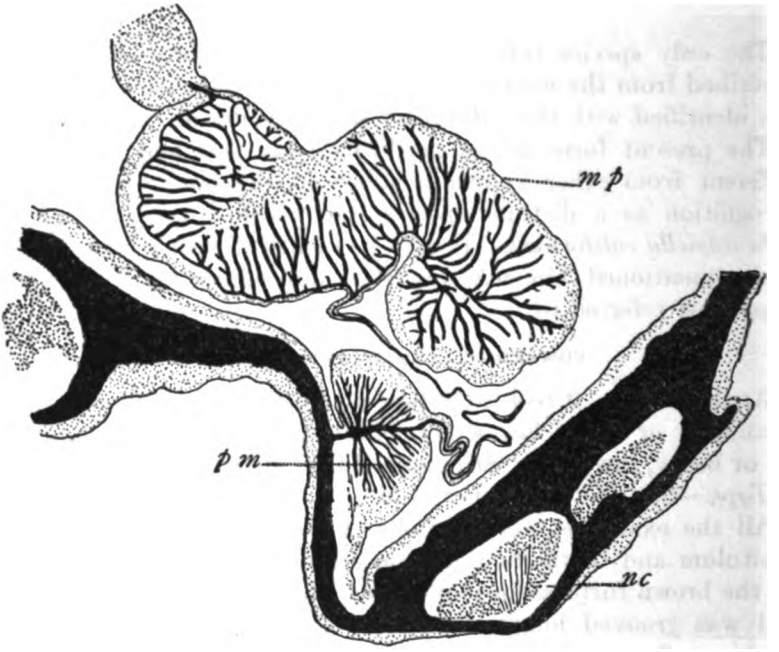


FIG. 1.—TRANSVERSE SECTION OF A PROTOCNEMIC MESENTERY OF EDWARDSIELLA CALIFORNICA. *mp*, MUSCLE PENNON; *nc*, NEMATOCYST CAPSULE; *pm*, PARIETAL MUSCLE.

The muscle pennons of the protocnemes have a very characteristic pattern. They resemble those of *E. pudica* (=*E. adenensis* Faurot) in that the mesenteries join them almost at the middle of their breadth (fig. 1), a condition that evidently results from the excessive development of the lateral or basal lamella of the pennon, which seems to be a direct continuation of the axial mesoglœa of the pennon and, like it, bears numerous lamellæ, which, however, are secondary branches. In *E. pudica* these are arranged bipinnately on the basal lamella, but in the present species, while the more proximal ones are arranged in a palisade-like manner on one side of the basal lamella, more distally the latter breaks up into a number of irregularly branching plates, so that the lateral portion of the pennon has the appear-

Digitized by Google

ance of a rounded lobe. Throughout the portion of the pennon medial to the point of attachment of the mesentery, the lamellæ, though branching to a greater or less extent, have a palisade arrangement, gradually diminishing in height, however, to a point about midway between the attachment of the mesentery and the medial edge of the pennon, beyond which point they again rapidly increase in height; there is thus a marked separation between a medial and a more lateral group of lamellæ.

There are about 16 well developed lamellæ in the medial set and about 9 in the more lateral one, while the basal lamella bears about 14 secondary ones, the total number being, therefore, about 39 or 40. A slight thickening of the endoderm over the medial edge of pennon is noticeable, but it is less pronounced than in many other species.

The parietal muscles are very well developed, consisting of about 8 more or less branched lamellæ on either side of the main axis, their relative breadths being such as to give the cross section of the entire muscle a more or less hemispherical or rounded conical outline.

Digitized by Google

Digitized by Google

DESCRIPTIONS OF TEN NEW GENERA AND TWENTY-THREE NEW SPECIES OF ICHNEUMON-FLIES.

By H. L. Viereck,

Of the Bureau of Entomology, United States Department of Agriculture.

This paper deals chiefly with reared species sent to the Bureau of Entomology, United States Department of Agriculture, for determination.

Family ALYSIIDÆ.

CŒLINIDEA, new genus.

This name is proposed for *Cœlinius* Authors not Nees, *Cœlinius* Nees being isogenotypic with *Chænon* Curtis.

Type.—(*Stephanus*) *Cœlinius niger* (Nees).

ERICŒLINIUS, new genus.

Related to *Cœlinidea* Viereck, from which it can be distinguished by the vertex surpassing the upper plane of the lateral ocelli and by the notauli not meeting posteriorly, in both of which characters it agrees with *Cœlinius* Nees, from which it differs in the *Cœlinidea*-like venation and in the sternauli attaining the anterior edge of the mesopleurse.

Type.—*Cœlinius longulus* Ashmead.

Family BRACONIDÆ.

ÆROPHILOPSIS, new subgenus.

This subgenus, judging from the original description, agrees best with *Ærophilus* Szepligeti, from which it differs in the notauli being at most developed only along the anterior edge of the dorsulum, in the mesopleurse having a furrow, in the more or less areolate or rugose propodeum and in the round propodeal spiracles.

Type.—*Bassus* (*Ærophilopsis*) *erythrogaster*, new species.

BASSUS (ÆROPHILOPSIS) ERYTHROGASTER, new species.

Type-locality.—Vienna, Virginia.

Type.—Cat. No. 15276, U.S.N.M.

Male.—Length 4 mm.; black and shining; fore and mid tarsi brownish, hind coxæ, trochanters and femora mostly reddish; abdomen reddish.

Digitized by Google

Labeled, "May 14, 1911, R. A. Cushman, collector."

Paratopotypes collected May 15 and 17 in the same year show variation in color and in abdominal sculpture, some having the metapleuræ reddish and the hind trochanters blackish, while others have the transverse furrows of the abdomen more conspicuously longitudinally striate than the type. A paratype labeled "Stafford, Conn., 24, August, 1905, on flowers of goldenrod, W. E. Britton, collector," has the hind coxæ mostly blackish.

MACROCENTRUS (AMICROPLUS) PLESIUS, new species.

Type-locality.—Chapel Hill, Tennessee.

Allotype-locality.—Vienna, Virginia.

Type.—Cat. No. 15277, U.S.N.M.

Female.—Length 3 mm.; closely related to *M.* (*A.*) *crambivorus* Viereck, from which it may be separated by the transversely striate propodeum and by the more slender first, dorsal, abdominal segment which is apparently at least three times as long as wide at apex, rounded off and not at all subbicarinate longitudinally.

Allotype.—Differs from *M.* (*A.*) *crambivorus* Viereck chiefly in the first, dorsal, abdominal segment not being subbicarinate longitudinally and in the stramineous metapleuræ.

Labeled, "Webster No. 8254, Chapel Hill, Tenn., G. G. Ainslie, collector, and Webster No. 9253, Vienna, Va., R. A. Cushman, collector, reared from *Crambus.*"

The atopoparatypes of *M.* (*A.*) *crambivorus* Viereck, with the exception of those labeled "from unknown pupa, August 18," all belong to this species which may prove to be a southern race of the former.

APANTELES (APANTELES) LASPEYRESIÆ, new species.

Type-locality.—National Forest, Shasta, California.

Type.—Cat. No. 15278, U.S.N.M.

Female.—Length 3.5 mm.; related to *A.* (*A*) *aristotelis* Viereck, from which it differs especially in the first and second joints of the maxillary palpi and in the labial palpi being blackish, in the mostly brownish stramineous, fore femora, in the brownish stramineous tip of the mid femora, in the mostly brownish stramineous mid tibiæ and tarsi, in the wings being brownish with blackish veins and stigma, the latter however stramineous at base; in the propodeum being finely sculptured and dull with a poorly defined areola; in the first, dorsal, abdominal plate which is hardly more than one and one-half times as long as wide at base and with a faint median longitudinal depression on the apical half, and in the second, dorsal, abdominal plate being uniformly sculptured by rather radiating striæ.

Allotype.—Essentially as in the type.

Labeled, "Hopk. U. S. No. 11414*a*, reared May 11–27, 1912, from *Laspeyresia torenta* Grote on *Pinus ponderosa*, J. M. Miller, collector."

Digitized by Google

APANTELES (APANTELES) PHYCODIS, new species.

Type-locality.—Bangalore, India.

Type.—Cat. No. 15279, U.S.N.M.

Female.—Length 2.5 mm. Related to *A.* (*A.*) *megathymi* Riley, from the original description of which it differs in the palpi being stramineous, in the legs being yellowish excepting the coxæ, trochanters, basal two-thirds of mid femora, hind femora and apex of hind tibiæ which are black or blackish with the hind femora partly reddish, in the stigma which is yellowish with a blackish border, in the tegulæ which are black, in the areola which is irregularly triangular, in the absence of costulæ, in the first, abdominal plate which is rather wrinkled and provided with a shallow fossa on the apical half, in the second, abdominal plate which is vaguely sculptured.

Allotopotype.—Essentially as in the type except that the apical half of the hind tibiæ and the hind metatarsi are rather blackish.

Labeled, "Parasite on *Phycodes radiata*, Nov. 28, 1911, L. C. Coleman, collector."

APANTELES (APANTELES) PLUSIÆ, new species.

Type-locality.—Bangalore, India.

Type.—Cat. No. 15280, U.S.N.M.

Female.—Length 2.5 mm. Related to *A.* (*A.*) *megathymi* Riley, from the original description of which it differs in the legs and tegulæ being colored nearly as in *A.* (*A.*) *phycodis* Viereck, in the second, abdominal plate which is intimately united with the third, dorsal, segment, and in the ovipositor which is a little shorter than the abdomen. From the latter species this differs chiefly in the presence of costulæ, in the first, dorsal plate being distinctly narrower at apex than at base and in the second, dorsal plate being virtually scuptureless and less than half as wide at base as at apex.

Allotopotype.—Essentially as in the type.

Labeled, "Parasite on *Plusia agramma*, Feb. 17, 1911, L. C. Coleman, collector."

ATANYCOLIMORPHA, new genus.

Related to *Atanycolus* Foerster, from which it can be distinguished chiefly by the scape which is of the type found in *Cœloidimorpha* Viereck, the nonexcavate front and in the absence of foveolæ in the furrow between the second and third, dorsal segments.

Type.—*Atanycolimorpha winnemanæ*, new species.

ATANYCOLIMORPHA WINNEMANÆ, new species.

Type-locality.—Plummers Island, Montgomery County, Maryland.

Type.—Cat. No. 15281, U.S.N.M.

Female.—Length 8 mm. Agrees with the original description of (*Bracon*) *Atanycolimorpha? provancheri* Dalla Torre, except that the

Digitized by Google

embossed median area of the second, dorsal segment can hardly be said to be short in that it extends fully three-fourths the distance from base to apex.

This species may prove to be the same as the species with which it is compared.

Paratopotypes show variation in length, some being smaller than the type.

This species was found investigating a log of cedar.

CAMPYLONEURUS RUGATOR (Say).

Bracon rugator SAY, Boston Journ. Nat. Hist., vol. 1, 1836, p. 251, female.—LECONTE, Writ. Th. Say. Ent., vol. 2, 1859, p. 704, female.
Bracon mavoritus CRESSON, Trans. Amer. Ent. Soc., vol. 4, 1872, p. 186, female.
Bracon novitus CRESSON, Trans. Amer. Ent. Soc., vol. 4, 1872, p. 186, male.

CHELONUS (CHELONELLA) BUSSYI, new species.

Type-locality.—Deli, Sumatra.

Type.—Cat. No. 15282, U.S.N.M.

Female.—Length, 3 mm. Apparently related to *C.* (*C.*) *orientalis* Szepligeti, from the original description of which it differs in the clypeus being finely punctured, in the mesonotum in front being rather dull and sculptured, in the disk of the scutel being punctured, the punctured area bounded by foveæ, in the reticulated propodeum, in the first abscissa of the radius being curved, apparently thicker and shorter than the second and not forming a straight line with the second, in the uniformly yellowish scape, in the fore and mid femora being blackish except for the pale base and apex, in the fore and mid tarsi being more or less infuscated but pale at base of each joint, in the hind metatarsus being mostly pale and in the basal three-sevenths of the carapace and the annulus of the hind tibae being yellowish.

Allotype.—Flagel 22-jointed; mouth of the anal fissure four times as wide as long; otherwise essentially as in the type.

Labeled, "No. 5.1, May ?, 1912, reared from *Gnorimoschema*, sp., collected by Dr. L. P. de Bussy."

Named for Dr. L. P. de Bussy.

COELOIDIMORPHA, new genus.

Related to *Coeloides* Wesmael, from which it differs chiefly in the different scape and in the second, dorsal, abdominal segment not being divided into three lobes by an oblique furrow on each side extending from base to apex.

Type.—*Bracon* (*Melanobracon*) *webbi* Viereck.

CRASSOMICRODUS FENESTRATUS, new species.

Type-locality.—Porto Rico.

Type.—Cat. No. 15283, U.S.N.M.

Female.—Length 8 mm. Essentially as in the genotype, from which it differs chiefly in color and in the coarser sculpture of the

Digitized by Google

propodeum. Black; upper, hind angles of the pronotum and the mesonotum reddish, tegulæ and base of fore wings stramineous, wings blackish except for the almost colorless membrane in the first submarginal and third, discoidal cells; propodeum very coarsely rugose; abdomen smooth and polished and reddish except for the basal half, and apical middle of the first, dorsal segment which are mostly black or blackish.

Labeled, "No. 390."

Received from C. W. Hooker.

EPIRHYSSALUS ATRICEPS (Ashmead).

Rhyssalus atriceps (ASHMEAD) Proc. U. S. Nat. Mus., 1888, p. 628, male, female.

EPIRHYSSALUS LOXOTENIÆ (Ashmead).

Rhyssalus loxoteniæ ASHMEAD, Proc. U. S. Nat. Mus., 1888, p. 628, male, female.

EPIRHYSSALUS SIMILIS (Ashmead).

Rhyssalus similis ASHMEAD, Proc. U. S. Nat. Mus., 1888, p. 628, male.

EUAGATHIS CRYPTOPHLEBIÆ, new species.

Type-locality.—Davanhalli; Mysore, India.

Type.—Cat. No. 15284, U.S.N.M.

Female.—Length, 5 mm. Judging from the original description, this species is related to *E. flavus* Szepligeti, from which, as described in the original, it differs in the absence of a branch to the second transverse cubitus, in the antennæ being blackish throughout, in the tarsi, all of which are yellowish, in the abdomen, which is entirely yellow, and in the general yellowish instead of reddish yellow color.

Labeled, "Parasite No. ii on *Cryptophlebia carpophaga*, Nov. 30, 1911, L. C. Coleman, collector."

EUTRICHOPSIS OSCINIDIS (Ashmead).

Rhyssalus oscinidis ASHMEAD, Proc. U. S. Nat Mus., 1888, p. 630, male.

HETEROSPILUS SELANDRIÆ (Ashmead).

Rhyssalus selandriæ ASHMEAD, Proc. U. S. Nat. Mus., 1888, p. 629, female.

HORMIUS TRILINEATUS (Ashmead).

Rhyssalus trilineatus ASHMEAD, Proc. U. S. Nat. Mus., 1888, p. 29, male.

HYSTEROBOLUS, new genus.

This remarkable Euphorine should replace *Euphoridea* Ashmead in Szepligeti's arrangement in the genera Insectorum, where *Euphoridea* Ashmead is misplaced. In Ashmead's arrangement it would seem to be related to *Dinocampus* Foerster, from which it differs radically in the shape of the head, which is almost cubical, being apparently as long antero-posteriorly as seen from above as the transfacial line, and

Digitized by Google

in the facial line being a little longer than the transfacial line, in the sharply defined notauli, in the prominently elevated and margined scutel, in the venation, which is quite as in *Blacus* Nees, except that the third abscissa is distinctly developed and nearly as long as the recurrent vein, and in the propodeum having a great conical production on each side of the posterior face, the cones extending backward and slightly outward.

Type.—*Hyster obolus mallochi*, new species.

HYSTEROBOLUS MALLOCHI, new species.

Type-locality.—Rosslyn, Virginia.

Type.—Cat. No. 15285, U.S.N.M.

Female.—Length, 2.5 mm.; black, shining excepting the propodeum and metapleuræ, which are dull; head polished excepting the face, which is mostly wrinkled, vertex with a shallow furrow extending from between the lateral ocelli to the occipital carina, malar line apparently as long as the eyes are wide in the middle, clypeus truncate, blackish at base, dark castaneous at apex, labrum and mandibles castaneous, palpi stramineous, antennæ brownish, the first flagellar joint nearly as long as the next two joints combined, flagel 16-jointed, the end joint nearly as long as the two preceding joints combined and blackish, anterior ocellus nearer to the lateral ocelli than the latter are to each other, the shortest distance between the eyes and the lateral ocelli much greater than the distance between the lateral ocelli; upper margin of prothorax and mesopleuræ as well as the mesonotum and scutel castaneous, the lobes of the mesonotum and the scutel partly covered with blackish stains, tegulæ and base of stigma stramineous, wings with a deep brownish stain, rest of stigma and veins mostly blackish, legs brownish stramineous except the hind femora, which are rather reddish with blackish tips, and the hind tibae, which are rather castaneous, mesopleuræ with a fossa at the hind edge; propodeum rugulose, not areolated; petiole carinate above and laterally, second, dorsal segment rather castaneous with blackish stains, the first segment sculptured, the remaining segments smooth and polished and compressed; exserted portion of ovipositor nearly twice as long as the apical truncature of the abdomen.

Labeled, "Sept. 22, 1912, J. R. Malloch, collector."

Named for my colleague, Mr. J. R. Malloch.

METEORUS LAPHYGMÆ, new species.

Type-locality.—Brownsville, Texas.

Type.—Cat. No. 15286, U.S.N.M.

Female.—Length 4 mm. Closely related to *M. hyphantriæ* Riley, from which it differs apparently only in the uniformly pale stramineous color of the body and its appendages and in the relatively smaller stigma.

Digitized by Google

Allotype.—Essentially as in the type.

Labeled, "Webster No. 6446, Bur. Ent., U. S. Dept. Agr. July 22–29, 1912, reared from the fall army worm, E. G. Smyth, collector."

This species may prove to be only a race or variety of *M. hyphantriæ* Riley.

MONOGONOGASTRA VENTRALIS (Cresson).

Bracon ventralis CRESSON, Proc. Ent. Soc. Phila., vol. 4, 1865, p. 76, female, Mayaguez, Porto Rico, Feb. 5, 1912 (C. W. Hooker).

PERILITUS ELEODIS, new species.

Type-locality.—Argonia, Kansas.

Type.—Cat. No. 15287, U.S.N.M.

Female.—Length 2 mm. Closely related to *P. gastrophysæ* Ashmead, of which it may prove to be only a variety and from which it differs chiefly in the paler color, being more or less stramineous where *P. gastrophysæ* Ashmead is brownish or castaneous, in the more finely sculptured propodeum and post petiole and in the mesopleuræ having rather an indefinitely circumscribed roughened area in place of a roughened fossa.

Allotype.—Essentially as in the type.

Labeled, "Webster No. 8221, E. G. Kelly, reared from *Eleodes suturalis.*"

The cocoons are elliptical and whitish, and 3 mm. by 1 mm.

Specimens from Belvidere, Nebraska, received from C. E. Ward and labeled "No. 4994 on *Eleodes suturalis*, May 15, 1891," are mostly stramineous.

According to C. E. Ward the parasitized beetle was confined April 27, 1891, and on the following day a lot of larvæ were noticed crawling about. Thus nearly three weeks elapsed between the time the larvæ left the host and the emergence of the parasites.

APANTELES (PROTAPANTELES) CONGREGATUS (Say).

Neotype-locality.—Greenville, South Carolina.

Neotype.—In the collection of the U. S. National Museum.

Female.—Length 2.5 mm. Related to *A.* (*P.*) *griffini* Viereck and *A.* (*P.*) *læviceps* Ashmead, from which it may be known by the third, dorsal, abdominal segment being nearly twice as long as the fourth and apparently one and one-half times as long as the second plate, and in the poorly developed median, longitudinal, propodeal carina; from the latter species with which it agrees best in size and color it differs also in the first abscissa of the radius being as long as the transverse cubitus; from the former species it differs also in the entirely blackish antennæ.

Digitized by Google

Alloneotype.—Essentially as in the neotype. Some specimens in their stramineous color show a relationship to *A.* (*P.*) *hemileucæ* Riley. This species is also related to *A.* (*P.*) *schizuræ* Ashmead.

Labeled, "bred from *Ceratomia catalpæ*, Sept. 18, 1912, E. B. Mason, collector."

APANTELES (PROTAPANTELES) EMPRETIÆ, new species.

Apanteles empretiæ ASHMEAD, Ms. Smith's. Ins. N. J. (1899), 1900.

Type-locality.—Washington, District of Columbia.

Type.—Cat. No. 12756, U.S.N.M.

Female.—Length 2 mm. Related to *A.* (*P.*) *fiskei* Viereck, but readily distinguished from that species by many of the following characters. Subopaque, sericeous; head above smooth and shining, apparently impunctate, face finely punctured, without a median welt, labrum, mandibles, scape and pedicel stramineous, palpi whitish, flagel brownish; thorax closely punctured, the scutel, however, sparsely punctured with rather large punctures, the interstices polished, mesopleuræ hardly punctured, wings hyaline, costa, stigma, first abscissa of the radius, transverse cubitus and third abscissa of the cubitus brownish, rest of the veins rather stramineous, the transverse cubitus a little shorter than the first abscissa of the radius; legs and tegulæ mostly stramineous including the fore and mid coxæ rather reddish brown, apical two-thirds of hind tibiæ, hind metatarsus and second joint of hind tarsi mostly blackish; abdomen with its first and second plates and most of the third dorsal segment rugulose, black except the membranous part of the first and second, dorsal segments and the first and second, ventral segments which are stramineous; ovipositor hardly exserted.

Allotype.—Essentially as in the type, except that the third, dorsal, abdominal segment is mostly smooth and polished. Cocoons parchment like, separate but arranged side by side on the back of the full-grown larva of the host.

Labeled, "No. 209°, parasite on (*Empretia*) *Sibine stimulea*, Aug. 31, 1888, Div. Ent. U. S. Dept. Agric."

One female paratopotype has the third, dorsal segment almost entirely smooth as in the allotype.

Paratypes labeled "No. 2837°, 11/4, 1885, Div. Ent. U. S. Dept. Agric. and Hyattsville, Md. Aug. 4, 1912, F. Knab" indicate that the third, dorsal, abdominal segment is normally sculptured down the middle with the sides mostly smooth and shining. The new cocoons of the Hyattsville specimens are rather lemon yellow while the old cocoons collected twenty-four years ago are brownish white.

Paratypes labeled "No. 295°, 14/5, 1883, Div. Ent. U. S. Dept. Agric." have the abdominal plates reddish brown with the hind

Digitized by Google

coxæ somewhat reddish brown or brownish stramineous and the third, dorsal, abdominal segment almost entirely smooth and shining.

Paratypes labeled "Bred from No. 209. Oct. 18, 1906, Orlando, Fla., Oct. 15, 1906, A. W. Morrill, collector," have reddish brown hind coxæ, the third, dorsal, abdominal segment sculptured down the middle and rather yellowish cocoons that are fading to a brownish white color.

The specimens with pale hind coxæ probably represent a southern race of this species.

All the specimens examined were reared from *Sibine stimulea*.

APANTELES (PROTAPANTELES) MAYAGUEZENSIS, new species.

Type-locality.—Mayaguez, Porto Rico.

Type.—Cat. No. 15289, U.S.N.M.

Female.—Length 2 mm. Apparently related to *P. marginiventris* (Cresson), from which it differs especially as follows: Antennæ mostly brownish, palpi stramineous with castaneous tips; hind coxæ mostly black, stramineous beneath; propodeum without a distinct median, longitudinal carina; sides and apex of the apical half of the dorsum of the abdomen mostly black or blackish.

Labeled, "453–455, October 29, 1910."

Received from C. W. Hooker.

OPIUS (UTETES) ANASTREPHÆ, new species.

Type-locality.—Mayaguez, Porto Rico.

Type.—Cat. No. 15290, U.S.N.M.

Female.—Length 3 mm. Related to *Opius* (*Utetes*) *interstitialis* Ashmead as originally described and represented by paratypes in the United States National Museum. Like *O.* (*U.*) *interstitialis* Ashmead, this species has the notauli developed on the anterior third of the dorsulum but not beyond. Scape and pedicel stramineous, flagel probably blackish; propodeum polished, irregularly reticulated with a basal transverse carina and a median, longitudinal carina on the basal third; first, dorsal, abdominal segment polished, the apical half with a median, longitudinal crista, second, dorsal segment without shallow, oblique furrows at base; exserted portion of ovipositor at least half as long as the abdomen.

Allotype.—Essentially as in the type but with the apical half of the abdomen brownish or blackish.

Labeled, "Reared from *Anastrepha* sp. No. 5063, Sept., 6, 7, 12, 1912, C. W. Hooker, collector."

A female paratopotype has a triangular elevated area on the apical half of the first, dorsal segment, with the base of the triangular area at the apex of the segment.

Digitized by Google

Family ICHNEUMONIDÆ.

EIPHOSOMA (BRACHIXIPHOSOMA) INSULARIS, new species.

Type-locality.—Mayaguez, Porto Rico.

Type.—Cat. No. 15291, U.S.N.M.

Female.—Length 11 mm. Apparently most closely related to *E. nigrovittatum* Cresson, from the original description of which it can be distinguished by the differently colored legs, the fore and mid coxæ and trochanters being yellowish, the rest of the fore and mid legs mostly stramineous, hind coxæ reddish and yellowish, hind trochanters mostly brownish, hind femora mostly reddish, hind tibiæ mostly dark brownish stramineous, hind tarsi black; abdomen mostly reddish.

Allotype.—Essentially as in the type.

Labeled, "C. W. Hooker, collector, Jan. 27, 29, 1912."

CHRISTOLIMORPHA, new genus.

Sternauli extending back to the hind edge of the mesopleuræ and sending out a branch furrow that extends upward and forward, meeting the prepectal carina near the upper end. Related to *Christolia* Brullé.

Type.—*Christolimorpha plesius*, new species.

CHRISTOLIMORPHA PLESIUS, new species.

Type-locality.—Mayaguez, Porto Rico.

Type.—Cat. No. 15292, U.S.N.M.

Female.—Length 6.5 mm. Closely related to (*Christolia*) *Christolimorpha ruficeps* (Cameron), from which it may be known by the propodeal processes being more conical and the only part of the propodeum that is luteous, by the mostly black first, dorsal, abdominal segment and by the nervellus being without a branch.

Allotopotype.—Essentially as in the type except that the spiracles of the first, abdominal segment are nearer to each other than to the apex and the propodeal processes are represented by a smooth whitish area.

Labeled, "C. W. Hooker, collector, Jan. 12, 1912."

DIAPETIMORPHA, new genus.

Apparently related to *Diapetus* Cameron, from the original description of which it differs in the propodeum being rugose or otherwise sculptured and not broadly depressed at base in the middle, in the spiracles being oval, in the apical transverse carina being confused with the rugæ except at the depressed processes, in the cubitus not uniting with the radius, in the recurrent vein which is not interstitial, in the notauli not meeting, in the spiracles of the first dorsal, abdominal segment which are nearer to the apex than to each other, in the

Digitized by Google

clypeus which is not separated from the face by a furrow, in the nervulus and basal vein being interstitial, and in the nervellus which is branched below the middle. This genus belongs in the Mesostenini.

Type.—*Cryptus armatus* Ashmead.

ENICOSPILUS HELIOTHIDIS, new species.

Type-locality.—Deli, Sumatra.

Type.—Cat. No. 15293, U.S.N.M.

Female.—Length 14.5 mm. Judging from Morley's arrangment of Asiatic species of this genus this species appears to be related to *E. reticulatus* Cameron, but that species is said to have the stigma nigrescent whereas in the present species the stigma is stramineous. The distal corneous mark is linear and appearing as an interrupted tail to the proximal corneous mark.

Allotype.—Essentially as in the type.

Labeled, "No. 2.2.4, 2.2.5, and 2.2.6, parasite of *Heliothis obsoleta*, June, 1911, collected by Dr. L. P. de Bussy."

ETHÆMORPHA, new genus.

Apparently related to *Etha* Cameron, from the original description of which it differs in the pentangular areolet which is distinctly angled below, in the recurrent vein being received beyond the middle, in the antennæ not being thickened beyond the middle, in the teeth of the mandibles not being equal, in the notauli being absent, in the third abdominal segment not becoming dilated toward the apex, and in the tarsi of the fore legs not being twice as long as the fore tibiæ and with the exception of the first joint not incised at the base.

Type.—*Cryptus similis* Cresson.

ITOPLECTIS EVETRIÆ, new species.

Type-locality.—Yreka, California.

Type.—Cat. No. 15294, U.S.N.M.

Male.—Length 6 mm. Compared with a female homotype of *Pimpla atrocoxalis* Cresson this species differs in color in having blackish tips to the hind femora, in having the hind tibiæ and tarsi black except for a whitish annulus on the basal half of the former, the basal two-thirds of the hind metatarsus mostly and the base of the second and third joints of the hind tarsi whitish, in the mid legs which have a whitish annulus on the basal half of the reddish tibiæ, while the tarsi are colored as in the hind legs and in the black flagel. Structural differences are the presence of a ramellus and almost perfectly round propodeal spiracles.

Labeled, "Hopk. U. S. No. 11415 b., reared May, 1912, prob. pars. on *Evetria* sp., *Pseudostuga taxifolia* cone; J. M. Miller, collector."

Digitized by Google

MESOCHORUS PLUSIÆPHILUS, new species.

Type-locality.—Bangalore, India.

Type.—Cat. No. 15295, U.S.N.M.

Female.—Length 2.5 mm. In Thomson's classic revision of some European species of this genus this species would appear to come nearest to his group *ee*, from which it can readily be distinguished by the nervulus, which is antefurcal. Stramineous; apical half of antennæ mostly brownish, face punctured, mandibles with brown tips; wings including stigma concolorous and yellowish excepting the veins which are brownish, nervulus shorter than the distance between it and the basal vein, areolet quadrangular and almost forming a right-angled triangle; hind tibiæ nearly as broad as the hind femora; propodeum blackish above, areola hexagonal, narrower at base than at apex, the costulæ joining the former nearer the apex than the base; petiole as long as the post-petiole and the lateral margins of the apical half blackish, lateral margins of the second, dorsal, abdominal segment blackish; sheaths of the ovipositor dark brown or blackish and a little longer than the post-petiole.

Labeled, "Parasite No. 11 on *Plusia agramma*, December 17, 1911; L. C. Coleman, collector."

This is a hyperparasite and probably parasitic on *Apanteles plusiæ* Viereck or on a *Meteorus*.

MESOSTENIMORPHA, new genus.

Habitus as in *Crypturopsis* Ashmead, with which in the main it agrees, except in the areolet, which is as in *Cryptus* Fabricius, in the presence of an apical transverse carina, in addition to the propodeal spines and in having the median longitudinal carinæ feebly developed.

Type.—*Cryptus nebraskensis* Ashmead.

MYRMICOMORPHA, new subgenus.

Related to Pezomachus Gravenhorst, from which it can be separated by the mesonotum and propoduem being separated by an anteroposteriorly long furrow, at the bottom of which is a suggestion of a scutel, the scutel being as long dorsally as the pronotum.

Type.—*Pezomachus* (*Myrmicomorpha*) *perniciosa*, new species.

PEZOMACHUS (MYRMICOMORPHA) PERNICIOSA, new species.

Type-locality.—Brownsville, Texas.

Type.—No. 15296, U.S.N.M.

Female.—Length 4 mm. Has characters in common with *P. spiraculus* Strickland, from which it may be distinguished especially by the slender antennæ, which are rather brownish stramineous except at the tip where they are fuscous, by the first joint of the flagel being nearly eight times as long as thick at apex, by the almost uniformly

Digitized by Google

brownish stramineous body and appendages, by the completely exareolate propodeum which is subconical and virtually without carinæ except for vestiges of the apical transverse carina on each side of this sclerite.

Labeled, "Webster No. 6446, Bur. Ent. U. S. Dept. Agric., July 24–29, 1912, reared from cocoons of *Meteorus laphygmae* Viereck; E. G. Smyth, collector."

The flagel is 20-jointed in the type and 19-jointed in a paratopotype.

NEOTHERONIA WINNEMANÆ, new species.

Type-locality.—Plummer's Island, Maryland.

Type.—Cat. No. 15297, U.S.N.M.

Female.—Length 11.5 mm. Related to *N. septemtrionalis* Krieger, from the original description of which it differs in the following particulars: Flagel 47-jointed; the blackish spots of the fore wings occupying the apex of the marginal cell and the upper inner corner of the second submarginal cell; first, dorsal, abdominal segment with a transverse blackish band just behind the spiracles; apical tarsal joint of hind tarsi blackish. The type was taken by the writer August 4, 1912, between 5 and 6 p. m., as it was flying through the woods.

In a paratopotype collected November 9, 1902, by H. S. Barber, the seventh, dorsal, abdominal segment has a subbasal transverse blackish band.

ORTHOCRYPTUS, new genus.

Related to *Apsilops* (Foerster) Ashmead, from which it differs chiefly in the malar line, which is shorter than the mandibles are wide at base, in the more typically Cryptine propodeum in which the basal transverse carina and the apical transverse carina alone are prominent, and in the almost slitlike propodeal spiracles.

Type.—*Cryptus monticola* Ashmead.

PHYGADEUON (PLESIGNATHUS) EPOCHRÆ, new species.

Type-locality.—Bozeman, Montana.

Type.—Cat. No. 15298, U.S.N.M.

Female.—Length 3 mm. Judging from Schmiedeknecht's arrangement of European species of *Phygadeuon* this species is related to *P. lapponicus* Thomson and *P. læviventris* Thomson. From the former, as described by the author cited, it differs in the brownish stramineous coxæ, in the blackish stigma, in the outer angle of the discocubital cell being obtuse, and in the first and second joints of the flagel in the female being brownish. From the latter species, as described by the author cited, it differs in the rather slender femora, in the third, dorsal, abdominal segment of the male being brownish

Digitized by Google

stramineous, in the hind coxæ being mostly blackish, and in the hind femora being brownish stramineous beneath.

Allotopotype.—Essentially as in the type, except as noted above, and in having the flagel black throughout.

Labeled, "Parasite on *Epochra canadensis*, May 27, 1912." Received by the Bureau of Entomology, United States Dept. of Agriculture, from Prof. R. A. Cooley.

Digitized by Google

NOTES ON SOME FOSSIL HORSES, WITH DESCRIPTIONS OF FOUR NEW SPECIES.

By Oliver P. Hay,
Research Associate of the Carnegie Institution of Washington.

The results detailed in the present paper have been arrived at during the writer's studies on the Pleistocene Vertebrata of North America, pursued under the auspices of the Carnegie Institution of Washington. The materials here mentioned are preserved in various collections, as follows: In the United States National Museum; the Academy of Natural Sciences of Philadelphia; the Wagner Free Institute of Science, Philadelphia; the American Museum of Natural History, New York; Yale University Museum, and the University of Kansas. To the officers of these institutions the thanks of the writer are due for freely given permission to study these materials. Especially is the writer indebted to the University of Kansas for permission to describe the fine skull made the type of *Equus laurentius*, and for photographs of it; and to the Carnegie Institution of Washington for permission to publish in advance these results.

EQUUS FRATERNUS Leidy.

In 1901 Mr. J. W. Gidley, now of the United States National Museum, published a valuable paper on the fossil horses of North America.[1] However, in that paper, as it seems to the present writer, Mr. Gidley fell into certain errors which it seems desirable should be corrected.

In discussing the status of Leidy's *Equus fraternus*, Mr. Gidley came to the conclusion that Cope,[2] in choosing out of the number of teeth which Leidy had included under his species, had picked out the wrong tooth as the type of *E. fraternus*. Mr. Gidley, therefore, selected another tooth as type of this species, the one which Leidy represented by figure 8 of plate 15 in Holmes's Post-pliocene Fossils of South Carolina. However, the tooth taken by Cope as the type was one of those before Leidy when he gave the name, and he likewise figured it in the same publication (pl. 15, fig. 6). It must, therefore, according to the established rules of nomenclature, remain the type

[1] Bull. Amer. Mus. Nat. Hist., vol. 14, pp. 91-142, pls. 18-21, figs. 1-25.
[2] Proc. Amer. Philos. Soc., vol. 34, p. 467.

Digitized by Google

of this species. This tooth is now in the American Museum of Natural History and has the catalogue No. 9202. The tooth selected by Gidley is in the same museum and bears the number 9200.

Mr. Gidley concluded, furthermore, that the type tooth selected by Cope has no characters by means of which it can be distinguished from *Equus complicatus*. The present writer agrees with him that this type, figured by Leidy[1] and again by Mr. Gidley, with some restoration,[2] is too large to belong to the same species as those teeth represented by Leidy's figures 8 and 16 of the plate referred to, and those figured by Gidley and designated as C and D. The fore-and-aft diameter of the crown is 27 mm.; but, inasmuch as the tooth had been worn down to within 35 mm. of the root, this diameter was originally probably somewhat greater, 29 mm., or even 30 mm. The width is 29.5 mm., somewhat greater than that of the type of *E. complicatus*. This is too great to permit us to suppose that the

FIGS. 1-3.—1, EQUUS FRATERNUS. ×1. RIGHT UPPER PREMOLAR. 11489, YALE. 2, LEFT UPPER PREMOLAR. 11489, YALE. 3, RIGHT UPPER PREMOLAR. 11483, YALE.

tooth belonged to the Floridan horse with teeth of medium size which the name *fraternus* has generally been supposed to designate.

Whether or not we ought to regard the name *E. fraternus* as a synonym of *E. complicatus* is another question. We may not be able to distinguish the larger teeth found in that region from those of *E. complicatus;* neither does our insufficient knowledge of them enable us to say positively that they belong to the last-named species. Figures of some of these teeth of questionable species, found on our south Atlantic coast, are here presented. Figure 1 represents the grinding surface of a right upper tooth, apparently a third or fourth premolar, which is in the Yale collection, No. 11489. It is stated that it was found in the phosphate beds near Charleston, South Carolina. It had suffered only moderate wear, the crown having yet a height of 75 mm. The fore-and-aft diameter of the grinding surface (called the length of the tooth in this paper) is 31 mm.; the width, 27 mm. Another (fig. 2), having the same number and from the same place, is more strongly worn, the height being only 55 mm.

[1] Proc. Amer. Philos. Soc., vol. 34, pl. 15, fig. 6.
[2] Bull. Amer. Mus. Nat. Hist., vol. 14, p. 112, fig. 8, B.

Digitized by Google

It belongs to the left side and is taken to be the third or fourth premolar. Its length is 32 mm., the width, 27.6 mm. A third tooth in the collection at Yale, found also in South Carolina, and having the number 11483, is represented by figure 3. It is the third or fourth right upper premolar. The height of the crown is 65 mm., the length 28 mm., the width 28 mm. The enamel is strongly folded. A fourth tooth, which belongs to the collection of the Wagner Free Institute, Philadelphia, appears to belong with those just described, although the enamel is much more plicated than in figures 1 and 2. It has the catalogue No. 4086, and is one of several teeth collected along Peace Creek, in 1888, by Mr. Joseph Willcox. This tooth (fig. 4) has the crown 72 mm. high, 31 mm. long, and 26 mm. wide. A part of the inner face of the tooth is missing. These teeth resemble closely those of *E. complicatus*, although some of them have the enamel little folded.

In the collection of the Wagner Free Institute is a part of a lower jaw of a horse of apparently medium or moderately large size. This jaw was obtained by Mr. Willcox on the Caloosahatchie River, Florida, in 1888. It furnishes the symphysis and a part of the left ramus, with the right third incisor, all the left incisors, and the second and third premolars. The animal was young, but mature. This jaw was referred to *Equus fraternus* by Cope.[1] According to Cope, Doctor Leidy also determined it as *Equus fraternus*. By Cope it was associated with two upper cheek teeth from Peace Creek. One of these, whose diameters are given as 29 mm. and 24 mm., may be the tooth represented here by figure 5. The other, not recognized with certainty, designated by Cope as "No. 2," measured fore and aft 25 mm., traversely 26 mm. In his measurements of the third premolar of the lower jaw Cope gives as the width 17 mm. It is probable that he included the cement. This is not practicable, because it is often missing in fossil teeth.

Measurements of the lower jaw.

	mm.
Length of the symphysis	75
Width of the symphysis where narrowest	40
Width of the symphysis at third incisors	53±
Height of jaw at front of $pm._2$	60
Height of jaw behind $pm._3$	82
Distance from $i._3$ to $pm._2$	82
Width of $i._1$	16
Width of $i._2$	17
Width of $i._3$	18
Length of grinding surface of $pm._2$	31
Width of grinding surface of $pm._2$	14.5
Height of crown of $pm._3$	76
Length of crown of $pm._3$	29
Width of crown of $pm._3$	15.5

[1] Proc. Amer. Philos. Soc., vol. 34, p. 465.

Digitized by Google

Figure 1, on plate 69, represents the little worn incisors of the jaw. It has been prepared from a photograph of a cast of the front of the jaw. It will be seen that none of the teeth has a complete cup. In the first and second incisors the cup is open to the bottom on the lingual side; while the third incisor shows only traces of the cup. It is this simple condition of the incisors that led Cope to base on this jaw his genus *Tomolabis*.[1]

Figure 6 shows the arrangement of the enamel in the second and third premolars. It is somewhat more complicated than usual in the corresponding teeth of species of *Equus*.

Because (1) of the close resemblance of the type tooth of *E. fraternus* to the tooth of *E. complicatus* and the possibility, even probability, that these species are identical, and (2) because the incisors of *E. complicatus* are very different from those of the lower jaw in the Wagner Free Institute, the writer was at first disposed to refer the jaw just mentioned to the species described below as *E. leidyi*. However, the third premolar seems to have the long diameter too great to belong with the type tooth of *E. leidyi;* although perhaps not too great to go with the tooth of figure 5 in case it belongs to *E. leidyi*. Under the circumstances, therefore, it seems best for the present, to retain the name of *E. fraternus* for those larger equine teeth which are found along our south Atlantic coast, and which approach more or less closely in size and structure the type of this species, as selected by Cope; furthermore, to associate with these teeth the lower jaw above described, following thus the example of Leidy and Cope. This appears to be the more advisable, because in the Peace Creek collection there are other lower teeth which it seems necessary to refer to *E. leidyi*, as noted below. It must be said, however, that it seems very probable that such teeth as those represented by figures 1 and 2 represent a species distinct from the typical *E. fraternus*.

EQUUS LEIDYI, new species.

Type.—One of six teeth in the Wagner Free Institute of Science, Philadelphia, which have the catalogue number 4086. Found in supposed Pleistocene deposits on Peace Creek, Florida.

Characterized by teeth of medium size, the length of the grinding surface of the first molar being about 25 mm., the width about 24 mm., excluding the cement. Enamel surrounding the lakes rather strongly folded. Type tooth moderately curved.

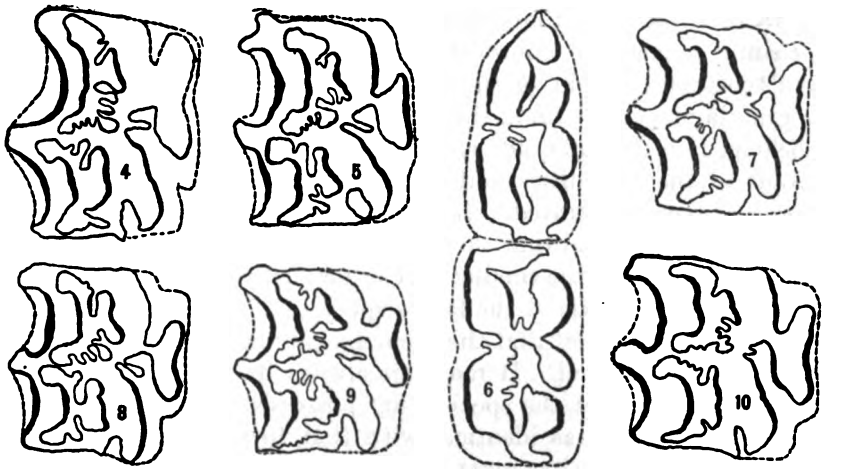
This name is intended to designate a horse which possessed teeth of medium size, examples of which have been found at various localities from North Carolina to Florida. Among these are certain teeth figured by Leidy [2] and others by Mr. Gidley. [3] As the special type of

[1] Proc. Amer. Philos. Soc., vol. 30, p. 125; vol. 34, p. 466.
[2] Holmes's Post-Pliocene Foss. S. C., pl. 15, figs. 8, 16.
[3] Bull. Amer. Mus. Nat. Hist., vol. 14, figs. 8, C. D.

Digitized by Google

the species there is taken a tooth (fig. 7) which belongs in the collection of the Wagner Free Institute and which is one of six found somewhere along Peace Creek by Mr. Joseph Willcox. It is impossible that all these teeth belonged to the same individual, and they probably did not belong all to the same species. One has already been referred to the species which it seems advisable to regard as *E. fraternus* (fig. 4). Two other teeth are referred to the species here described, and they may have belonged to the same individual (figs. 8, 9). The following are the dimensions of these teeth:

Teeth.	Height of crown.	Length of crown.	Width of crown.	Protocone.
	mm.	mm.	mm.	mm.
Tooth of fig. 7 (type)	75	25	24	11
Tooth of fig. 8	62	25	24	12
Tooth of fig. 9	75	25	23	11



FIGS. 4–10.—4, 6, 10, EQUUS FRATERNUS. × 1. 4066, WAGNER. 4, RIGHT UPPER MOLAR; 6, LEFT SECOND AND THIRD PREMOLARS; 10, RIGHT UPPER PREMOLAR? 5, 7, 8, 9, EQUUS LEIDYI. × 1. 4086, WAGNER. 5, RIGHT UPPER PREMOLAR; 7, RIGHT UPPER MOLAR. TYPE. 8, RIGHT UPPER MOLAR; 9, RIGHT UPPER PREMOLAR?

The tooth taken as the type is believed to be a molar, either the first or the second. The other two are supposed to be premolars. It will be observed that in these teeth the enamel surrounding the lakes is much folded on the adjacent borders, while the front border of the anterior lake and the hinder border of the posterior are deeply notched. The post-protoconal valley, that entering the tooth on the inner face, behind the protocone, lacks much of reaching outward halfway to the median style of the outer face of the tooth.

One of the six teeth mentioned is represented by figure 5. It is a right premolar, either the third or the fourth. The height of the crown is 62 mm., the length 28 mm., the width 24 mm. This prob-

Digitized by Google

ably belongs to the species here described; although the length of the grinding surface is equal to some teeth that are referred to *E. fraternus*. Still another of the six teeth is doubtful (fig. 10). The height of the crown is 37 mm., the length 25 mm., the width 27 mm. This may be a third or fourth premolar of *E. fraternus* which has a short grinding surface, because the tooth was worn down to one-half or less of its original length.

In the American Museum of Natural History are several horse teeth which were collected some years ago by Prof. F. W. Putnam, on the Alifia River, near its entrance into Tampa Bay. One is here figured (fig. 11). It belonged to the right side and is a premolar, the anterior outer style (parastyle) being flattened and furnished with a furrow. It is worn down one-half its length, the height of the crown being 35 mm. The length of the grinding surface is 24 mm., the width 24 mm., the protocone 12 mm. The enamel of the lakes is pretty strongly folded. This tooth is to be referred to *E. leidyi*. Figure 12 is likewise from Alifia River, but is a considerably larger tooth and appears to approach *E. fraternus*. This, too, is a well-worn tooth; the height of the crown being 40 mm. The length of the grinding face is 30 mm., the width 27 mm., the protocone 14 mm. It belonged on the right side and seems to be a premolar.

Some of the difficulties under which the student of fossil horses labors are here illustrated. It may be perfectly obvious that two species are present and that they differed in size; but the teeth of the larger individuals of the smaller species may equal in size the teeth of the smaller individuals of the larger species. The matter is likewise complicated by the fact that the premolars are larger than the molars of the same individual. It may not always be possible to identify single teeth; but that the species that possessed such teeth as those of figures 7 and 8 was identical with that furnishing the teeth of figures 1 and 2 the writer regards as very improbable.

In the collection from Peace Creek, with the No. 4086 of the Wagner Free Institute, are six lower teeth of medium size which the writer refers to *E. leidyi*. Two of these are little worn and appear to have belonged to the same individual; one on the left side, the other on the right (fig. 14). A third has the crown more worn (fig. 13). A fourth, the last left molar, seems to have the crown worn down to about two-thirds its original height.

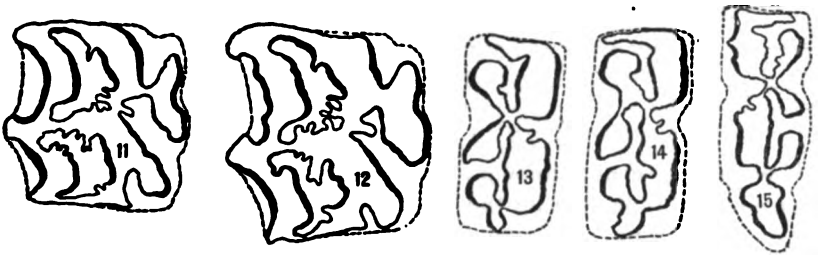
The following are the dimensions of the three figured:

Teeth.	Height of crown.	Length of crown.	Width of crown.
	mm.	mm.	mm.
Tooth of fig. 14	92	25	12
Tooth of fig. 13	.....	25	13
Tooth of fig. 15	66	30	11

These lower teeth are remarkable because of their narrowness.

Digitized by Google

In the case of the tooth of figure 14 the fore-and-aft diameter is taken about 25 mm. below the grinding surface, because there the normal dimension is reached. The diameter of the actual surface is 28 mm. The tooth of figure 15 is longer than the others, because it is the hindermost tooth. It will be observed that in length of grinding surface these teeth agree with the upper molars of *E. leidyi*, being too small to belong to *E. fraternus* and too large to have armed the lower



FIGS. 11-15.—11, EQUUS LEIDYI. × 1. RIGHT UPPER PREMOLAR. AMER. MUS. NAT. HIST. 12-15, EQUUS FRATERNUS. × 1. 12, RIGHT UPPER PREMOLAR? AMER. MUS. NAT. HIST. 13, LOWER RIGHT MOLAR OR PREMOLAR. 4086, WAGNER. 14, LOWER RIGHT MOLAR OR PREMOLAR. 4086, WAGNER. 15, LOWER LEFT LAST MOLAR. 4086, WAGNER.

jaw of the species next to be described. Figure 16 represents a lower left premolar or molar from Alifia River, Florida. The height of the crown is 61 mm., its length 27 mm., its width 11.5 mm. on the worn face, but lower down 13 mm. It differs from the teeth of figures 13, 14, and 15 in the more plicated enamel.

FIGS. 16-18.—16, EQUUS LEIDYI. × 1. LOWER LEFT MOLAR OR PREMOLAR. AMER. MUS. NAT. HIST. 17-18, EQUUS LITTORALIS. × 1. 17, UPPER LEFT MOLAR. TYPE. 4086, WAGNER. 18, UPPER LEFT MOLAR. 4086, WAGNER.

EQUUS LITTORALIS, new species.

Type.—One of six teeth in the Wagner Free Institute of Science, Philadelphia, which have the No. 4086. Found in supposed Pleistocene deposits on Peace Creek, Florida.

Characterized by teeth of small size, the grinding surface of the first molars having a length and a width of about 21 mm. Enamel surrounding the lakes rathe strongly folded. The crown somewhat more curved than in *E. leidyi*.

Accompanying the teeth found by Mr. Willcox on Peace Creek, as mentioned on page 573, are others which belonged to a smaller horse than that described as *E. leidyi*. Two of these teeth are left upper molars and are shown in figures 17 and 18. To this horse, believed

Digitized by Google

to be hitherto without a name, is given the title *Equus littoralis*. The tooth represented by figure 17 is taken as the type, but that of figure 18 certainly belonged to the same species, possibly to the same individual. The anterior half of the outer wall of enamel of the type has been split off.

The following are the dimensions of these teeth:

Teeth.	Height of crown.	Length of crown.	Width of crown.	Protocone.
	mm.	mm.	mm.	mm.
Tooth of fig. 17 (type)	62	21	20	
Tooth of fig. 18	40	21.5	22	

These teeth seem somewhat more curved than those of *E. leidyi*. A curved line representing the hinder border of the outer face has its chord 62 mm. long, and its middle point is about 6.5 mm. distant from the chord. The chord of the inner face is 53 mm. long and the middle point of the face is 7 mm. distant from the chord. The post-protocone valley, as represented by the two teeth at hand, is narrow and falls much short of reaching half way to the median style of the outer face of the tooth. No lower teeth are known that agree in size with the upper teeth described above.

Mr. Gidley[1] states that there are in the American Museum of Natural History a small tooth from Peace Creek, Florida, and another from Lookout Mountain, Tennessee. It is suggested that these may belong to Owen's *Equus tau*, a species described from the Valley of Mexico. The present writer has not seen these teeth, but from Gidley's measurements, taken from Owen's figures, as well as from Owen's statement, it is to be noted that in all the premolars and molars the length of the grinding surface is greater than the width, whereas, in the teeth of *E. littoralis*, the width is greater than the length. Moreover, Owen's figure indicates no such complexity of the enamel in *E. tau* as characterizes the teeth of *E. littoralis*.

EQUUS NIOBRARENSIS, new species.

Type.—A nearly complete skull belonging to the United States National Museum and having the catalogue number 4999. Found in supposed lower Pleistocene deposits, at Hay Springs, Nebraska.

Characterized by teeth of rather large size, the length of the grinding surface of the first molar being about 27 mm., the width about the same. Enamel of the lakes of rather simple pattern.

The skull to which the name *Equus niobrarensis* is here given was discovered in 1886 by Prof. J. B. Hatcher, along the Niobrara River near Hay Springs, Nebraska. When found it was in a more or less broken condition, and it was afterwards put in its present state by Mr. Alban Stewart. As shown by plate 69, figs. 2, 3, and plate 70, the bone

[1] Bull. Amer. Mus. Nat. Hist: vol. 14, p. 121.

Digitized by Google

lacking to some extent on the sides and middle of the face and here and there in other places; but the structure of the essential parts is evident. Other remains of evidently the same horse have been collected at Hay Springs and the neighboring region for the United States National Museum and the American Museum of Natural History, in New York. Some of these were identified by Mr. Gidley as *Equus complicatus*,[1] and the left side of the upper jaw of one specimen, No. 2725, was figured[2] under this name. In the same paper[3] Mr. Gidley figured and identified as *E. complicatus* the left upper cheek teeth of a specimen which he had found in the canyon of Tule Creek, in Swisher County, Texas. This specimen likewise appears to belong to *E. niobrarensis*.

It is proper to say here that before the writer began to study the skull here described Mr. Gidley had recognized it as belonging to an undescribed species.

Below are found measurements which have been taken from the skull, No. 4999, United States National Museum. In another column are presented corresponding measurements taken on the skull of a domestic horse, No. 843, of the United States National Museum. The age of the latter seems to have been about 6 years, while the Niobrara horse appears to have been approximately a year younger. As the lower jaw of the skull, No. 843, of the domestic horse is missing, measurements of this part are supplied from No. 174960 of the United States National Museum, a large gelding, whose skull has a length of 640 mm. The upper row of cheek teeth, however, measures the same as in No. 843.

Measurements of skull in millimeters.

Distances.	*E. niobrarensis.*	*E. caballus.*
	mm	mm
From middle of incisive border to front of foramen magnum	530	550
From middle of incisive border to front of posterior nares	290	300
From middle of incisive border to rear of notch between nasal and premaxillæ	200	196
From middle of incisive border to rear of occipital crest	582	602
From middle of incisive border to front of $pm.^2$	137	143
From middle of incisive border to front of orbit	340	362
Width across mastoid processes	110	129
Width across hinder nares	47	55
Width across articulation for lower jaw	217	213
Width from outside to outside of last molars	123	127
Width from outside to outside of outer incisors	78	75
Distance between fronts of orbits	158	158
Distance between the rear of the orbits	240	220
Width of skull on maxillary ridge at maxillo-malar suture	187	183
Width of palate at last molars	70	77
Width of palate at $pm.^2$	50	53
Distance across premaxillæ at middle of nasal opening	75	67
Least width of space between $i.^3$ and $pm.^2$	45	45
Distance between $i.^3$ and $pm.^2$	105	110
Diameter of orbit, fore and aft	84	70
From front of lower jaw to rear of ascending ramus	467	.....
Length of symphysis of lower jaw	90	.....
Height of jaw at front of $m._1$	96	.....
Rear of $i._3$ to front of $pm._2$	93	.....

[1] Bull. Amer. Mus. Nat. Hist., vol. 14, p. 132. [2] Idem., pl. 18, fig. B. [3] Page 132, fig. 22.

Digitized by Google

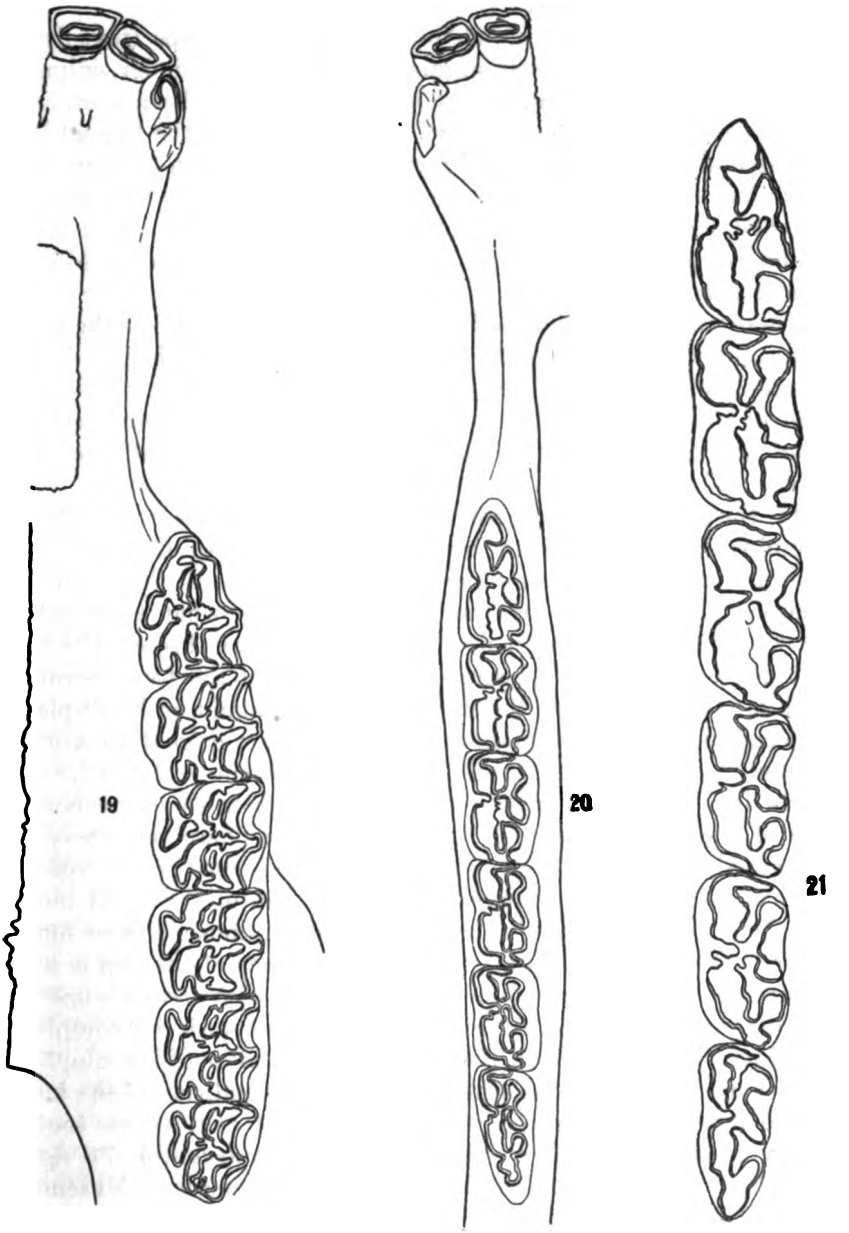
Measurements of the teeth.

Teeth.	Upper.		Lower.	
	E. niobrarensis.	*E. caballus.*	*E. niobrarensis.*	*E. caballus.*
	mm.	mm.	mm.	mm.
Length molar-premolar series	179	185	180	187
Length premolar series	98	98.5	94	97
Length molar series	81	86	84	90
Height of crown of $m.^3$	78			
$Pm.^2$, length	38	40	35	36
width	27	27	15	16
protocone	10	10		
$Pm.^3$, length	30	30	28	30
width	28	29	16	17.5
protocone	13.5	14		
$Pm.^4$, length	29	29	30	30
width	27	30	16	17
protocone	14	15		
$M.^1$ length	27	27	27.5	27
width	28	29	14	15
protocone	13	15		
$M.^2$, length	27	28	27	28
width	26	28	13.5	15
protocone	14	16		
$M.^3$, length	26	31	30	34
width	23	25	13	14
protocone	14	16.5		
$I.^1$, diameter, side to side	19	16	17	16
diameter, fore and aft	13	11.5	11	11
$I.^2$, diameter, side to side	20	18	17	19
diameter, fore and aft	12	11	11	11
$I.^3$, diameter, side to side	21	20	17	17
diameter, fore and aft	11	11	11	13

Having compared many of the measurements of the skulls, as given above, with the length, it is found that the ratios in the two species are not greatly different. Nevertheless, as will be seen from the table on page 590, the skull is wider in the present species than in the domestic horse and the nose is rather short. The size of the brain case is remarkable. Its width, measured above the hinder root of the zygomatic arch, is 122 mm. In the skull of the domestic horse, No. 843, the width is 115 mm. It will be seen that the teeth agree closely in their dimensions with those of *E. caballus*, although those of the fossil species are somewhat wider, above and below. It appears therefore necessary to find most of the specific differences in the structure of the teeth. In general the arrangement of the enamel of the cheek teeth is simpler than in the domestic horse, as seen on the hinder border of the anterior and the front border of the posterior lakes (fig. 19). Here the enamel band has merely one or two short loops, whereas in the domestic horse it is almost always considerably crinkled. The valley which enters the face of the tooth from the lingual side, the post-protoconal valley, appears usually to extend farther outward than in the domestic horse. In the latter the distance from the inner wall of the protocone to the anterior and outer extremity of the post-protoconal valley is equal to or less than the distance from the latter point to the enamel wall of the median ridge, or style, on the outer face of the tooth. In *E. niobrarensis*

Digitized by Google

the valley is usually extended somewhat farther toward the outward face. Here, as in other characters, deviations from the rule are to be expected.



FIGS. 19–21.—19, EQUUS NIOBRARENSIS. × ½. UPPER JAW, LEFT SIDE. TYPE. 4999, U. S. NAT. MUS. 20, LEFT LOWER JAW. TYPE. 4999, U. S. NAT. MUS. 21, LEFT LOWER JAW. 2725, AMER. MUS. NAT. HIST.

In the lower cheek teeth, both premolars and molars (fig. 20), the loop of enamel which enters the crown at the middle of the outer

Digitized by Google

face is short, not being permitted to push itself in between the adjacent ends of the two longitudinal loops of enamel. In the domestic horse the outer valley insinuates itself between the two longitudinal loops of the true molars.

The first and second upper incisors have deep cups (text-fig. 19; pl. 69, fig. 4). If there was originally a notch on the hinder, or lingual, lip of the cup of the first incisors, all traces of it have been worn away. There seems to have been a very shallow notch on the lingual lip of the second incisor. The third incisors had just begun to suffer wear. Each has a cup about 20 mm. deep, but the lip on the lingual side is notched nearly to the bottom of the cup. The hinder part of this lip rounds into the opposite, or buccal, lip, between the middle and hinder thirds of the latter.

There was evidently a shallow notch in the lingual lip of the second lower incisor (pl. 71, fig. 1). The cup of the third incisor is very incomplete. Its lingual lip is notched broadly and nearly to the bottom of the cup. This lip is represented by a descending ridge in front and by a tubercle about the middle of the lingual face of the tooth. The remainder of this face is concave transversely.

In the American Museum of Natural History is a mandibular symphysis which the writer regards as belonging to *E. niobrarensis*. It bears the collector's number 24. It presents all the permanent incisors, of which the first and second are somewhat worn (pl. 71, fig. 2). The third on each side had made its way through the bone, but not yet through the gum. Just outside of the front border of each is seen the root of the milk incisor just about to be displaced. The cup of the third permanent incisor has a low lingual lip, not well shown in the figure, but the bottom of the cup extends 25 mm. below it. This tooth is thus quite different from the corresponding one of the type. Doubtless here as in other characters there is a good deal of variation. Even in the domestic horse there is considerable variation in the completeness of the cup of the third incisor. Mr. Gidley [1] has referred to this variation and published three figures. Nevertheless in the domestic horse the absence of the cup is a rare occurrence; and we may expect to find in *E. niobrarensis* some condition that prevails. Possibly this tooth in the type is less completely developed than usual; or it is possible that the piece of jaw numbered 24 belongs really to some other species. The condition of the incisor in the type is not advanced really beyond that of the same tooth in a jaw that is referred provisionally to *E. excelsus* (pl. 71, fig 3). This has the catalogue number 2762 in the American Museum of Natural History.

The following notes and measurements have been taken from No. 2725 of the American Museum of Natural History, New York, the

[1] Bull. Amer. Mus. Nat. Hist., vol. 14, p. 103, fig. 5.

Digitized by Google

specimen figured by Gidley. By length of the tooth is meant, here as elsewhere, the fore-and-aft extent of the crown, not the height of the tooth. The fore-and-aft extent of the protocones is also given. It should be observed that in comparing the dimensions of the teeth, the lengths of *pm.*², *pm.*₃, *m.*³, and *m.*₃ are less constant than those of the other teeth.

Measurements of teeth.

	mm.
Length of the upper premolar-molar series	190
Length of the upper premolar series	107
Length of the upper molar series	83
*Pm.*², length	42
width	30
protocone	12
*Pm.*³, length	32
width	30
protocone	17
*Pm.*⁴, length	31
width	30
protocone	16
*M.*¹, length	30
width	27
protocone	14
*M.*², length	30
width	25
protocone	15
*M.*³, length	25
width	20
protocone	15

Besides the maxilla and cheek teeth described here the type specimen presents the premaxillæ, the incisors and both canines. With this upper jaw there is present also a part of a lower jaw which belonged to the same individual and which presents the left ramus and symphysis, with all the cheek teeth (fig. 21), the left canine and all the incisors.

Measurements of teeth.

	mm.
Length of premolar-molar series	200
Length of premolar series	110
Length of molar series	90
*Pm.*₂, length	38
width	17
*Pm.*₃, length	33
width	19
*Pm.*₄, length	32
width	18
*M.*₁, length	30
width	16
*M.*₂, length	32
width	15
*M.*₃, length	31
width	11

Digitized by Google

In the upper jaw the first and second incisors have a deep cup; the third incisor has the cup widely open on the hinder face of the tooth. The canines were just emerging from the bone.

In the lower jaw the first and second incisors are a little worn, while the third had just begun to be worn. The second has the hinder border of its cup a little notched; while the third is widely open, as in the same tooth of the type specimen. The canines were just coming through the bone very close to the third canine. From the figure of the lower teeth (fig. 21) it will be seen that the valley at the middle of the outer face does not, or hardly at all, push itself in between the adjacent ends of the longitudinal valleys. These teeth differ but slightly from those of figure 5.

Measurements of upper and lower jaws.

	mm.
Height of maxilla above $pm.^4$	105
Height of maxilla above $pm.^2$	71
Width of upper jaw at $i.^3$	76
From front of $pm.^2$ to canine (diastema)	66
From front of $pm.^2$ to front of premaxilla	137
Height of lower jaw at rear of $m._3$	123
Height of lower jaw at rear of $pm._2$	70
Width of lower jaw at $i._3$	65
Distance between $pm._2$ and $i._3$	90
Length of symphysis of lower jaw	82

It may be of value to describe some milk teeth which appear to belong to this species. In the collection of the American Museum of Natural History is a part of a right maxilla which contains the second, third, and fourth milk molars (fig. 22). It has the collector's number 81. The bases of the teeth are concealed and consequently one can determine only approximately the height of the crown. This appears to be about 45 mm. The state of wear of the teeth indicates a colt about 6 months old. At the stage of wear in which the teeth are found, the post-protoconal valley opens into the anterior lake. The fourth milk molar is but little worn. Probably about 3 millimeters ought on this account to be added to its width as given below.

Measurements of upper milk molars.

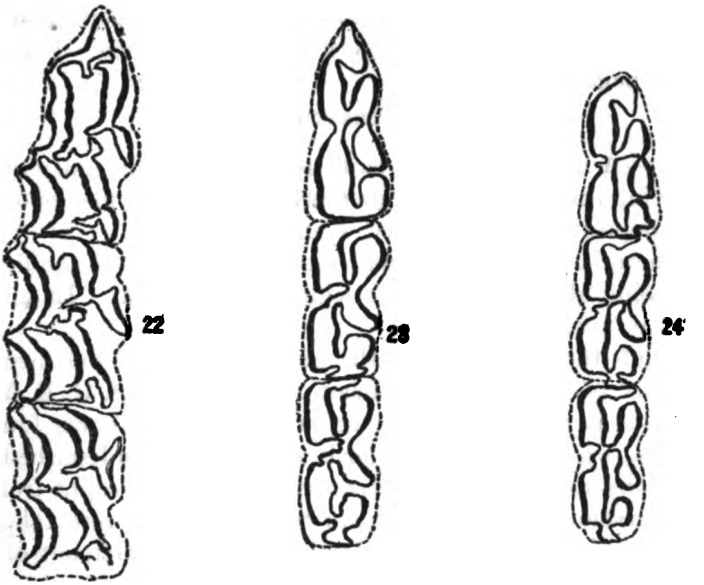
Teeth.	Length of grinding surface.	Width of grinding surface.	Protocone.
	mm.	mm.	mm.
$Dm.^2$	46	23	10
$Dm.^3$	34	24	9
$Dm.^4$	34	21	14

As is well known, the milk molars are distinguished from the premolars which succeed them by their relatively low crowns. It

Digitized by Google

will be observed also that these milk molars are both longer and narrower than the premolars.

In the American Museum of Natural History is a lower jaw of a young horse which the writer refers to *Equus niobrarensis*. It was found at Hay Springs, with the other remains obtained there. In this jaw there are present the three milk molars (fig. 23) and the anterior two permanent molars. The second of these is little worn. The first permanent incisors had not yet begun to wear and the others are missing from the specimen. The specimen is to be compared with a jaw of similar age described here under *E. excelsus* (fig. 24).



FIGS. 22-24.—22, EQUUS NIOBRARENSIS. × ⅓. AMER. MUS. NAT. HIST. RIGHT UPPER MILK MOLARS. 23, LEFT LOWER MILK MOLARS. 2758, AMER. MUS. NAT. HIST. 24, EQUUS EXCELSUS. × ⅓. LEFT LOWER MILK MOLARS. 2758, AMER. MUS. NAT. HIST.

Dimensions of the jaw and teeth of No. 2757, A. M. N. H.

	mm.
Length from front of jaw to rear of the ascending ramus parallel with the teeth	460
Length of the symphysis	95
Height in front of first milk molars, $dm._1$	72
Height in rear of third milk molars, $dm._4$	90
Height of condyle above the surface on which the jaw rests	235
Length of the space between last incisor and first milk molar, $dm._2$	82±
First milk molar, length	40
First milk molar, width	16
Second milk molar, length	32
Second milk molar, width	15.5
Third milk molar, length	33.5
Third milk molar, width	15
First true molar, length	33
First true molar, width	13

Digitized by Google

It is very probable that the width of the first true molar would have been considerably greater after it had been worn down further. It will be observed that the outer valley pushes itself in between the ends of the two longitudinal valleys in the second and third molars. The first permanent incisor is 19 mm. wide and the cup is complete.

From all ordinary specimens of *Equus complicatus* this species is distinguished by the smaller teeth and by the far simpler arrangement of the enamel. It is distinguished in the same way from *E. scotti*. In neither of the species just named does the post-protoconal valley usually extend so near the outer wall of the tooth as it does in *E. niobrarensis*.

It is important that this species should be distinguished from *E. excelsus*, which has teeth of practically the same size. For comparisons see page 592.

EQUUS LAURENTIUS, new species.

Type.—A nearly complete skull now in the University of Kansas and having the catalogue number 347. Derived from supposed Pleistocene deposits near Lawrence, Kansas.

Characterized by rather small teeth, the length of the first upper molar being about 22 mm., the width about 23 mm. Enamel of the lakes only moderately folded.

Through the generosity of the paleontological department of the University of Kansas, at the head of which is Prof. C. E. McClung, the writer is permitted to describe a skull of a horse found near Lawrence, which the writer regards as a hitherto undescribed species. It is hereby named *Equus laurentius*. The photographs from which the illustrations of the skull have been prepared were taken under the supervision of Mr. H. T. Martin, of the department of paleontology.

This skull (pls. 72, 73), which lacks no part except the extremities of the nasal bones, was found in 1910 on a sand bar on the north side of the Kansas River near North Lawrence. Prof. J. E. Todd tells the writer that with the skull were found the femur of a carnivore and the base of an elk's antler. The femur of the carnivore has been identified by Prof. Roy L. Moodie as belonging probably to *Smilodon*.

In 1903 there were secured, about 1 mile north of the place where the skull of the horse was found, some skulls of the existing bison, besides the horn core and hinder part of the skull of a bison which Professor McClung has described as *Bison kansensis*. The locality is given by Professor Todd as being about one-half mile north of Bismark Grove, which is itself about a mile and a half east of North Lawrence.

Digitized by Google

It is thought that all the remains mentioned, except probably the skulls of *Bison bison*, were derived from the same deposit. The writer has consulted Prof. J. E. Todd, of the University of Kansas, regarding the geological age of this deposit. He responds that the remains are from the level of the present river, which has been cut down nearly 100 feet since the ice of the Kansan stage was across the valley; and that he sees no geological reason for thinking that it has been many years since they were deposited in their resting place. He knows of no older bed in the vicinity from which they have been derived.

On the other hand, as the writer has endeavored to prove,[1] no native horse has left its remains on drift of the Wisconsin stage, from which fact it appears reasonable to infer that the native horses had by that time become extinct. The same statement appears to be true of the extinct species of bison and of the carnivores known as the saber-toothed cats. Moreover, the skull here described is believed to be specifically identical with a fine specimen from Hay Springs, Nebraska, at which place have been found also three species of camels. This specimen is described below. These considerations make it probable that the horse skull, the skull of *Bison kansensis*, and the femur identified by Professor Moodie as belonging to Smilodon belonged to a time antedating the Wisconsin drift stage. The skulls of *Bison bison*, found near Lawrence, are less thoroughly fossilized and are probably of a later time. It seems not unlikely that deposits of the Aftonian stage had been laid down in an old valley of the Kansas River and that the river is now attacking these deposits. This conclusion appears to be confirmed by the fact that teeth of a horse apparently identical with those of *E. laurentius* have been found in Aftonian deposits in western Iowa.

In describing the species of fossil horses we must continually deplore the fact that many of them resemble one another very closely. When one has the teeth only for study, one longs for complete skulls, which it is believed might furnish distinguished characters, but when these have come to hand it is found that one is little better off than before. The skulls and its parts, including the teeth, of what are certainly different species, are greatly alike in form and often in size. At the same time there is in the parts of each species of horse so much variation that it is often difficult to determine where are to be placed the lines which one is certain must be drawn somewhere. Only by careful work on all accessible materials can one hope to approach correct results, and future research must be depended on to eliminate such errors as may find their way into this paper.

[1] Smiths. Misc. Coll., vol. 59, p. 10.

Digitized by Google

The following measurements were taken from the skull found near Lawrence. It belonged to an individual probably 8 or 9 years old.

Measurements of skull.

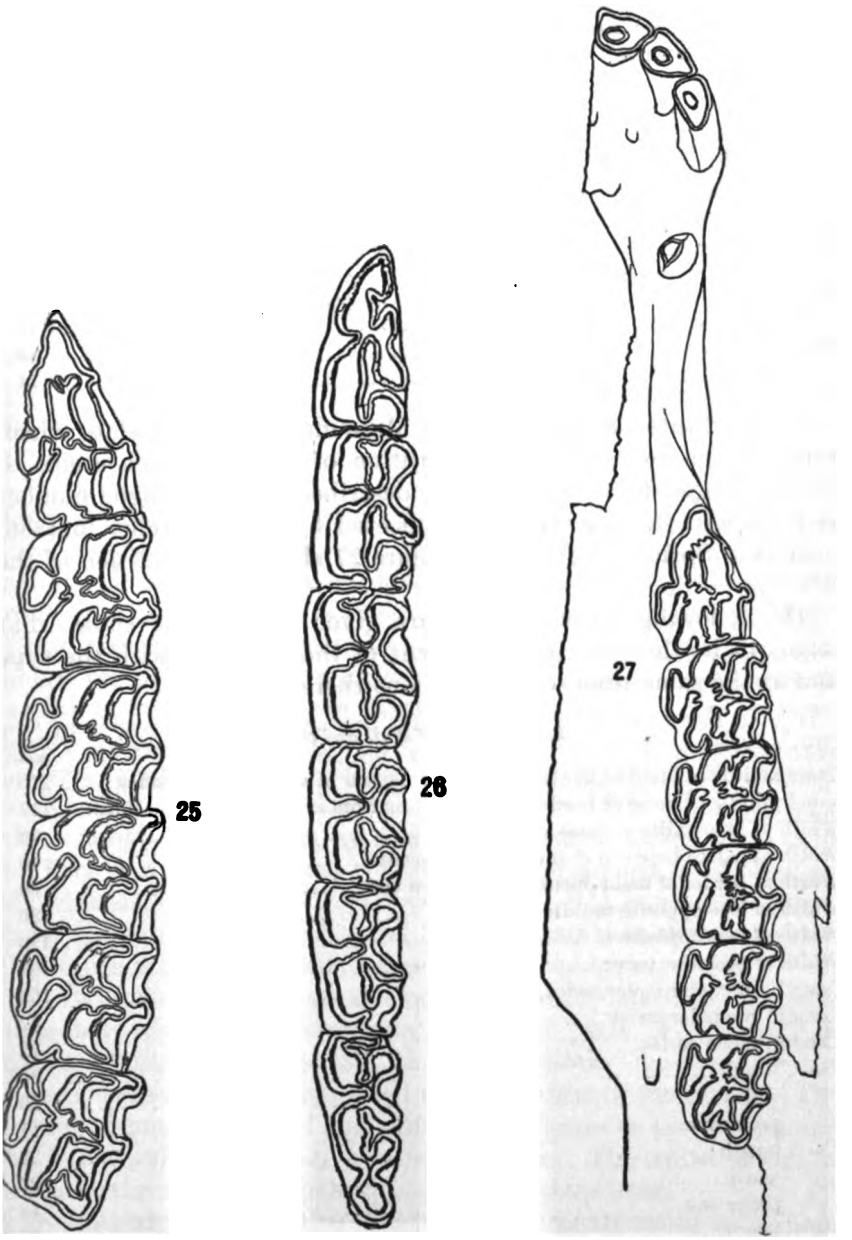
	mm.
From middle of incisive border to front of foramen magnum	481
From middle of incisive border to front of posterior nares	269
From middle of incisive border to naso-premaxillary notch	163
From middle of incisive border to middle of occipital crest	541
From middle of incisive border to front of pm^2	128
From middle of incisive border to front of orbit	283
From middle of incisive orbit to naso-premaxillary notch	183
Width across mastoid processes	117
Width across articulations for lower jaw	197
Width from outside to outside of last molars	132
Width from outside to outside of last premolars	127
Width from outside to outside of canines	61
Width from outside to outside of outer incisors	65
Width of skull at the front of the orbits	153
Width of skull at the rear of the orbits	287
Width of skull on maxillary ridge at maxillo-malar suture	177
Width of palate at last molars	73
Width of palate at pm^2	68
Width of palate at diastema, least	45
Length of orbit	68
From front of symphysis of lower jaw to rear of ascending ramus	415
Length of symphysis	82
Height of jaw at front of m_1	73
From rear of canine to front of pm_2	66
From front of canine to rear of i_3	5

It is to be noted that in measuring the width of the crowns of the teeth, both upper (fig. 25) and lower (fig. 26), the cement layer is not included; but the measurement is taken from outside to outside of the enamel.

Measurements of the upper teeth.

		mm.
Length of premolar-molar series, $pm.^2$–$m.^3$, inclusive		169
Length of premolar series		87
Length of molar series		73
$Pm.^2$,	length	35
	width	24.5
	protocone	8
$Pm.^3$,	length	26
	width	24.5
	protocone	9
$Pm.^4$,	length	25
	width	25
	protocone	10
$M.^1$,	length	22
	width	23.5
	protocone	10.5
$M.^2$,	length	23
	width	23.5
	protocone	13
$M.^3$,	length	30
	width	22
	protocone	14

Digitized by Google



FIGS. 25-27.—25, EQUUS LAURENTIUS. LEFT UPPER PREMOLARS AND MOLARS. × ¾. TYPE. UNIV. KANSAS. 26, LEFT LOWER PREMOLARS AND MOLARS. × ¾. TYPE. UNIV. KANSAS. 27, LEFT SIDE OF PALATE. × ¼. 4991, U. S. NAT. MUS.

Digitized by Google

Measurements of the lower teeth.

	mm.
Length of premolar-molar series, $pm._2$–$m._3$, inclusive	175
Length of premolar series	89
Length of molar series	86
$Pm._2$, length	32
width	15
$Pm._3$, length	28
width	16.5
$Pm._4$, length	29
width	16
$M._1$, length	25
width	15
$M._2$, length	26
width	14
$M._3$, length	30
width	14

In the United States National Museum there is a palate which presents the complete upper dentition of a horse which seems to have belonged to the species here described. Its catalogue number is 4991, and the specimen was collected by J. B. Hatcher in 1886, near Hay Springs, Nebraska. Figure 27 shows the dentition of the left side.

The following measurements are given in order to show what seems to be the essential agreement of the specimen with the type and at the same time some deviations therefrom:

Measurements of skull and teeth.

	mm.
From middle of incisive border to line joining rear of $m.^3$ of the two sides	275
From middle of incisive border to line joining front of $pm.^2$ of the two sides	117
Width of premaxillæ at base of $i.^3$	70
Width of palate between $c.$ and $pm.^2$, narrowest	40
Width at border of nasal opening just above last	69
Width of face opposite middle of $pm.^4$	136
Width of face opposite $m.^2$	180
Width of posterior nares	51
Length, premolar-molar series	158
Length, premolar series	87
Length, molar series	72
$Pm.^2$, length	36
width	23
protocone	11
$Pm.^3$, length	25
width	27
protocone	14
$Pm.^4$, length	25
width	25.4
protocone	15
$M.^1$, length	23
width	25
protocone	14

Digitized by Google

Measurements of skull and teeth—Continued.

		mm.
$M.^2$,	length	23
	width	24
	protocone	13
$M.^3$,	length	27
	width	21.5
	protocone	13
$i.^1$,	diameter from side to side	15
$i.^2$,	diameter from side to side	15
$i.^3$,	diameter from side to side	14

The cheek teeth are worn down to a height of about 50 mm. It is to be noted here that, while the diameters of the corresponding teeth in the two specimens are practically the same, the length of the protocones in No. 4991 is considerably greater than in the type-specimen. It appears, however, in general, that one must not place too much reliance in the size and form of the protocone in identifying species.

In the Lawrence specimen it will be seen that the axis of the postprotoconal valley in the third and the fourth premolars is directed nearly to the anterior outer corner of the tooth. In the molars the axis prolonged strikes the middle of the next tooth in front, or in the case of the last molar, the front of the next tooth. In the Hay Springs specimen the prolongation of the axis of all the molars reaches the anterior pillar of the next tooth in front or even farther in front. The front border of the anterior lakes is more deeply notched in the Hay Springs specimen than in that from Lawrence; and the same statement is true regarding the hinder border of the posterior lakes. In that border of the anterior lake which is opposite the head of the postprotoconal valley there is in the Hay Springs horse a double folding of the enamel resembling an M; whereas, in the horse from Lawrence, the fold is usually simple. From the table on pages 586 and 588 it is seen that the nose of the Hay Springs horse is slightly longer than in the type.

In the following table an attempt is made to determine the relations between the measurements of certain parts of the skull in *Equus caballus*, *E. niobrarensis*, and *E. laurentius*. In each case the shorter measurement is expressed as hundredths of the longer. The distance from the front of the premaxillary bones to the line joining the first cheek teeth, $pm.^2$, is called the nose. The width of this is taken at the middle of the length of the nasal opening.

In obtaining these ratios most of the measurements have been employed that are recommended by Prof. Henry F. Osborn in his paper Craniometry of the Equidæ.[1] The ratios have been obtained by multiplying the shorter length by 100 and dividing the product by the longer dimension.

[1] Mem. Amer. Mus. Nat. Hist., vol. 1, pp. 55-100.

Digitized by Google

Table of ratios.

Species and specimen.	Basilar length and width at glenoid fossæ.	Basilar length and width at rear of orbits.	Basilar length and width at front of orbits.	Basilar length and width on maxillary ridge at maxillomalar suture.	Basilar length and length to rear of orbit.	Basilar length and length of tooth line.	Basilar length and length of nose.
	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Equus caballus, 843, U.S.N.M.	39	40	27.8	34	76.6	33.6	25.1
E. caballus, 174960, U.S.N.M.	38.7	40	29.6	35	75.3	30.6	27.1
Arabian horse, No. 172454, U.S.N.M.	40	43	31.5	37	75	34.5	26.4
E. niobrarensis type	41	45	29.8	35.3	76	33.8	25.7
E. laurentius type	41	43	31.8	37	75	33.2	27.9

An examination of this table appears to show that *Equus caballus*, as represented by the two specimens used, stands out as a horse with a relatively narrow skull; the Arabian horse as one with a broad skull; *Equus niobrarensis* as one with a skull wide, especially at the glenoid fossæ and the orbits, but narrowing at the front of the jugals; while *Equus laurentius* has a broad skull and a rather long nose. It is possible that in the case of *E. niobrarensis* the width of the orbits has been somewhat increased by distortion; but this is not apparent to any considerable degree, and the distortion has certainly not affected the region across the glenoid fossæ. The Arabian horse which is mentioned above is supposed to be of pure blood. The skeleton was presented to the United States National Museum by the cartoonist Mr. Homer Davenport. It will be observed that the skull is relatively broad, but the face is not found to be particularly short. Shortness of face is given by Nehring[1] as the character of Arabian horses which distinguishes them from the large breeds of western Europe. Nevertheless, when Nehring's measurements of the face are employed to determine the ratio of the basilar length to the length of the line extending from the front of the premaxillæ to the middle of the line joining the rears of the orbits, there is found to be little or no difference between his so-called long-faced horses and the Arabs. In fact, the horse recorded by him as having the longest face, his number 51, has the facio-cephalic index only 72; whereas, his number 31, an Arab, has a facio-cephalic index of 75. It is to be remembered that Nehring's index for the length of the face is obtained, not by comparison with the basilar length, but with the distance from the rear of the orbit to the middle of the occipital crest.

As to *E. laurentius*, the type shows that the part in front of the orbit is relatively short; while the occipital crest is curved somewhat backward, but not so much as in the ass.

[1] Landw. Jahrb., vol. 13, p. 110.

Digitized by Google

A study of the arrangement of the enamel of *E. laurentius* shows that it is much like that of *E. niobrarensis;* and far more simple than in *E. complicatus.* The contiguous ends of the two lakes are about as much folded as in *E. niobrarensis,* probably more so. The post-protoconal valley differs from that of the latter species, being narrower and almost without a reentering loop at its inner end. Moreover, it is directed more nearly forward, and its extremity does not reach the center of the tooth.

In the lower jaw the cheek teeth have the enamel bands less crinkled than in *E. niobrarensis.* They differ from the latter in another respect. At the middle of the length of the outer, or buccal face of the tooth, there is a reentering loop, or valley, of enamel. In the species here described it will be seen that this valley pushes itself in between the adjacent ends of the two loops of enamel that run longitudinally near the middle of the tooth. Only in the two anterior premolars does this relation of the loops fail to develop. In the type of *E. niobrarensis* the longitudinal loops wholly exclude the outer loop. It will be noted further that the outer loop in *E. niobrarensis* is pretty deeply notched in its hinder side. The lower teeth of *E. laurentius* resemble, with respect to the loops, those of *E. caballus;* but those of the latter have a notch in the hinder border of the outer loop. It will be observed that the teeth of *E. laurentius* are smaller than those of *E. niobrarensis.*

In differentiating the present species from *E. excelsus* Leidy we are, at present, limited to comparison with the type specimen of the latter. This is in the United States National Museum. It was figured by Leidy [1] and again by Gidley.[2] It consists of a fragment of the right maxilla and the last upper premolar and the three molars. These four teeth measure in length but a little more than the corresponding teeth of *E. laurentius.* Three differences in the arrangement of the enamel are noted between the two species. (1) In *E. laurentius* the post-protoconal valley keeps closer to the lingual side of the tooth than in *E. excelsus.* (2) In the latter species the front border of the anterior lake is without notch and it swings backward in a curve to near the head of the post-protoconal valley and then turns abruptly outward to form a notch. In *E. laurentius* this front border is conspicuously notched; while, facing the head of the post-protoconal valley, the border rounds backward and outward to form a notch that is often M-shaped. (3) Both the front and the hinder borders of the posterior lake are more deeply notched than in *E. excelsus.* In general, there is in *E. laurentius* a higher degree of complication of the enamel than in *E. excelsus.*

[1] Ext. Mamm. Fauna Dak. and Nebr., pl. 21, fig. 31.
[2] Bull. Amer. Mus. Nat. Hist., vol. 14, p. 114, fig. 9.

Digitized by Google

EQUUS EXCELSUS Leidy.

Equus excelsus was, as already stated, described and figured by Dr. Joseph Leidy in 1869. The exact locality where the specimen was found is not known, but it was somewhere along the Loup River, approximately at the center of the present State of Nebraska.

The teeth of *E. excelsus* (type) are but little smaller than those of *E. niobrarensis*. That they may be compared, measurements are here given. Gidley's figure of these teeth[1] is accurate, except that the engraver has made it 4 mm. too short.

Measurements of teeth of the type of E. excelsus.

Teeth.	Type.	"112" A.M.N.H.
	mm.	mm.
Length of last premolar and 3 molars	107	113
Length of 3 molars	78	84
P^3, height	78	85
length	28	29
width	28	27.5
protocone	16	12.5
M^1, height	66	68
length	26	27
width	28	26
protocone	14.2	13.5
M^2, height	77	83
length	26	27
width	25	26
protocone	15.5	13
M^3, height	79	85
length	28	29
width	22	23
protocone	14	15

It will be seen that no important differences are to be found between the teeth of this species and those of *E. niobrarensis* as regards size. There appear, however, to be differences of specific value in their structure. The post-protoconal valley of *E. niobrarensis* is broader than that of *E. excelsus;* it extends nearer the center of the tooth, and it is more deeply notched at its anterior end. The front border of the anterior lake in *E. niobrarensis* is deeply notched, but not notched in *E. excelsus*. The form of this lake in the two species is very different. The hinder border of the posterior lake in *E. niobrarensis* is deeply notched; in *E. excelsus*, little or not at all.

In *E. niobrarensis* the post-palatine foramen is placed opposite the front half of the last molar; in the type of *E. excelsus*, it is opposite the front end of the second molar.

In the American Museum of Natural History is a fragment of a right upper jaw which furnishes the same teeth as the type does, the last premolar and the three molars (fig. 28). It bears the field number 112 and is part of a collection made at Hay Springs, Nebraska, in 1893, by Wortman, Peterson, and Gidley. For comparison the measurements are given in the second column of the preceding table.

[1] Bull. Amer. Mus. Nat. Hist., vol. 14, p. 114, fig. 9.

Digitized by Google

It must be observed that these teeth, as shown by the reduced height, are more worn than those of the type. Hence, each one originally had the grinding surface possibly slightly longer than it now is. It will be seen that the front border of most of the anterior lakes is slightly notched and likewise the hinder border of some of the posterior lakes. The post-protoconal valleys resemble those of the type of *E. excelsus*.

Figure 24 presents a view of the left lower milk molars of a jaw, No. 2758, from Hay Springs, now in the American Museum of Natural History. This jaw belonged to a colt of practically the same age as the jaw, No. 2757, described under *E. niobrarensis*, but slightly younger. $M._1$ is in use; $m._2$ is not quite through the bone; the permanent incisors had not begun to wear. The jaw is 100 mm. shorter than that numbered 2757.

Measurements of lower jaws.

	mm.
Front of jaw to rear of ascending ramus	360
Length of symphysis	63
Height of jaw at front of $dm._2$	60
Height of jaw at rear of $dm._4$	76
Height of condyle above lower border of jaw	220
$Dm._2$, length	32
width	12
$Dm._3$, length	30
width	13
$Dm._4$, length	32
width	12
$M._1$, length	32
width	11

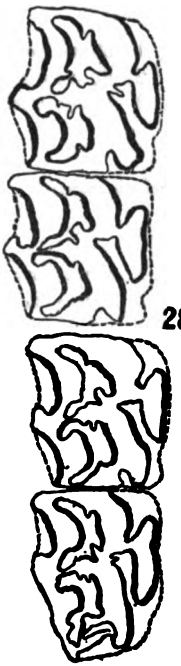


FIG. 28.—EQUUS EXCELSUS. LAST PREMOLAR AND THREE MOLARS OF RIGHT SIDE OF UPPER JAW. × ½. "112," AMER. MUS. NAT. HIST.

It is probable that most of these teeth, especially the last milk molar and the first true molar, have the grinding surface longer than it would have been at a little later stage of wear; and the true molar is narrower than it would have been later. On comparison of these milk molars with those supposed to belong to *E. niobrarensis*, it will be seen that the latter are both longer and considerably broader. Also the median outer valley pushes in between the longitudinal valleys, whereas they fail to do so in No. 2758.

It is impossible to refer this jaw with certainty to any described species, but it seems more probable that it belongs to *E. excelsus* than to any other known species. It may be stated that among the Hay Springs horses was one whose lower premolars and molars formed a row even longer than that of *E. niobrarensis;* but these teeth were much narrower.

Digitized by Google

EXPLANATION OF PLATES.

PLATE 69.

Fig. 1. *Equus fraternus*. Lower incisors. × 1. Wagner.
2. *Equus niobrarensis*. Skull viewed from above. × ½. Type.
3. *Equus niobrarensis*. Skull viewed from below. × ½. Type.
4. *Equus niobrarensis*. Upper incisors. × ¾. Type.

PLATE 70.

Equus niobrarensis. Skull seen from side. × ½. Type.

PLATE 71.

Fig. 1. *Equus niobrarensis*. Lower incisors. × 1. Type.
2. *Equus niobrarensis*. Lower incisors. × ¾. "24," Amer. Mus. Nat. Hist.
3. *Equus excelsus*? Lower incisors. × 1. 2762, Amer. Mus. Nat. Hist.

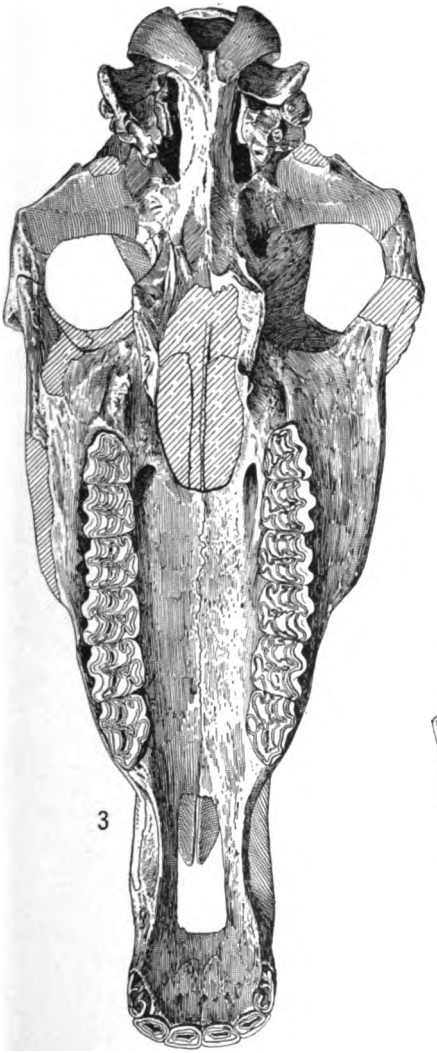
PLATE 72.

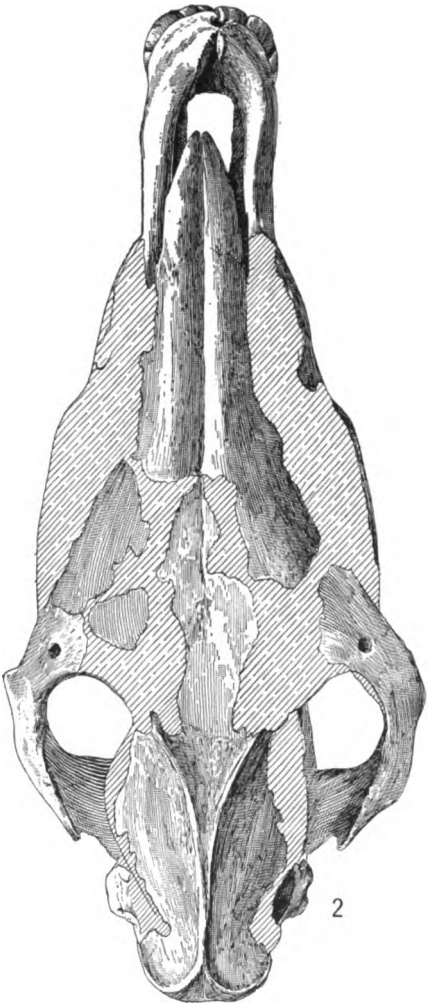
Equus laurentius. Skull viewed from the side. × ½. Type.

PLATE 73.

Fig. 1. *Equus laurentius*. Skull seen from above. × ½. Type.
2. *Equus laurentius*. Skull seen from below. × ½. Type.

Digitized by Google



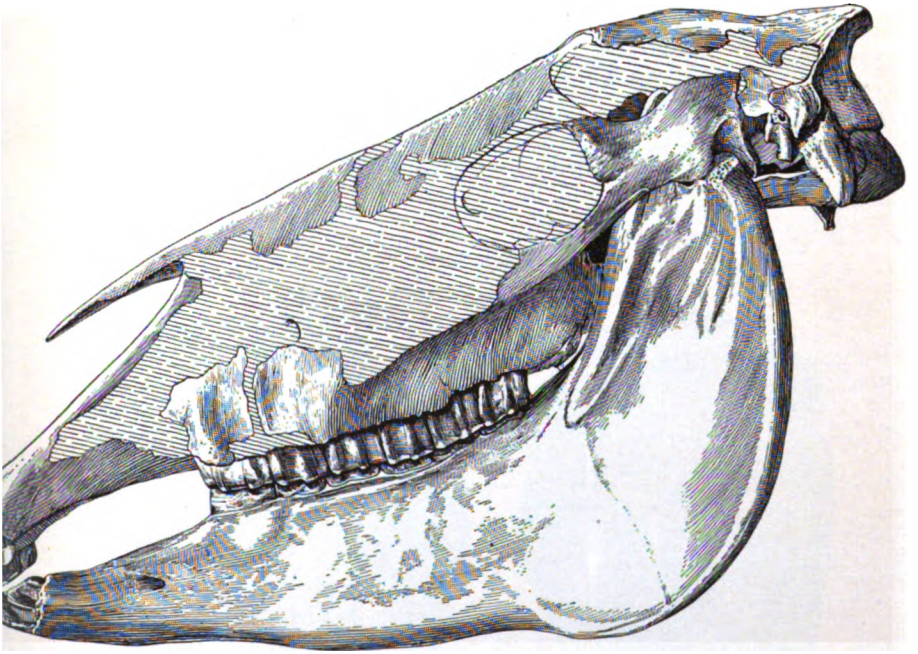


EQUUS FRATERNUS AND EQUUS NIOBRARENSIS.

FOR EXPLANATION OF PLATE SEE PAGE 594.

Digitized by Google

Digitized by Google



EQUUS NIOBRARENSIS.

FOR EXPLANATION OF PLATE SEE PAGE 594.

Digitized by Google

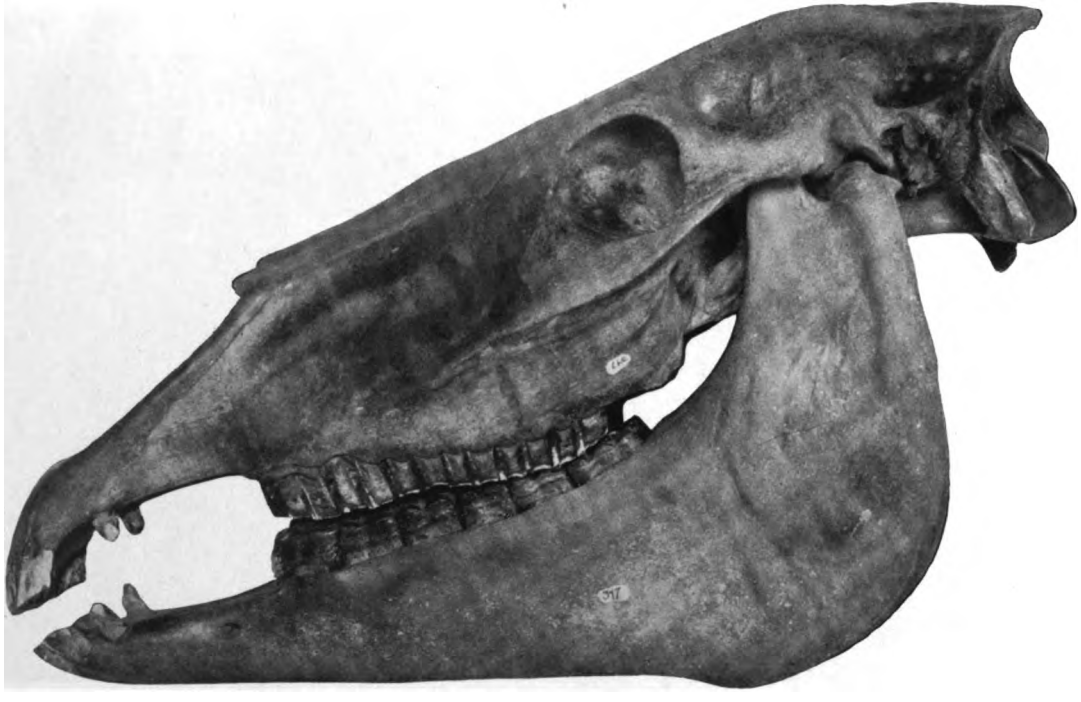
Digitized by Google

EQUUS NIOBRARENSIS AND EQUUS EXCELSUS?

FOR EXPLANATION OF PLATE SEE PAGE 594.

Digitized by Google

Digitized by Google



EQUUS LAURENTIUS.

FOR EXPLANATION OF PLATE SEE PAGE 594.

Digitized by Google

Digitized by Google

1 2

EQUUS LAURENTIUS.

FOR EXPLANATION OF PLATE SEE PAGE 594.

Digitized by Google

Digitized by Google

NOTES ON NEARCTIC ORTHOPTEROUS INSECTS. I. NONSALTATORIAL FORMS.

By A. N. CAUDELL,
Custodian of Orthoptera, United States National Museum.

In the course of preparing a new catalogue of the Orthoptera of the United States and Canada various points of systematic interest have arisen which seem best to publish prior to the issuing of the catalogue. In studying the material in the United States National Museum it was found convenient to construct keys to certain genera and species. Some of these keys, together with a few to higher groups, seem worth publishing as aids for the easy identification of native species. The present paper treats of matter of this character pertaining to the nonsaltatorial forms.

Family FORFICULIDÆ.

Recent classifications accord ordinal honors to this group, and it is well deserving of it. The same may be said of other families of the Orthoptera but in the catalogue now in course of preparation the old classification, placing the Forficulidæ as a family, is retained.

The Forficulidæ of the world have been divided into six families by the latest classification, that of Burr, Genera Insectorum, fasc. 122 (1911). This comprehensive work treats the earwigs as suborder Forficulina, the Hemimeridæ as suborder Hemimerina, and the interesting insect recently described by Jordan as *Arixenia esau* as suborder Arixenina, all three suborders constituting the order Dermaptera. The earwigs are here divided into six groups of family rank grouped into three superfamilies. Of these, six families of earwigs, which in the proposed catalogue of United States Orthoptera are designated as subfamilies, we have representatives of four. They may be separated as follows.

Key to subfamilies of nearctic Forficulidæ.[1]

a^1. Second tarsal segment prolonged beneath the third (fig. 1).

b^1. Second tarsal segment expanded, cordate.....FORFICULINÆ.

b^2. Second tarsal segment in no ways expanded.....CHELISOCHINÆ.

[1] In studying earwigs it is well to remember that the second segment of the antennæ is always very short, often scarcely noticeable, while the basal segment is large and long, usually broader than any of the others. Also it is useful to remember that the abdomen shows six ventral segments in the female and eight in the male as this is often of assistance in determining the sex when the structure of the forceps are not sufficiently distinctive, or these organs are missing.

Digitized by Google

a^2. Second tarsal segment not prolonged beneath the third.

b^1. Sixth segment of the antennæ usually clavate and always fully twice as long as the greatest width, usually distinctly more than twice as long, and, together with the fourth and fifth segments, generally longer than the basal segment (fig. 2) ..... LABIINÆ.

b^2. Sixth segment of the antennæ fusiform and almost never twice as long as the greatest width and, together with the fourth and fifth segments, rarely longer than the basal segment..... LABIDURINÆ.

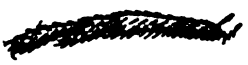


FIG. 1.—TARSUS OF FORFICULA SHOWING THE SECOND SEGMENT PROLONGED BENEATH THE THIRD.

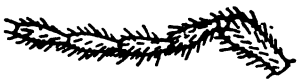


FIG. 2.—BASAL PORTION OF ANTENNA OF LABIA, SHOWING RELATIVE STRUCTURE OF THE SEGMENTS.

Of the subfamily Forficulinæ we have represented two genera, *Forficula* and *Doru*. These two genera and the species and varieties represented by each may be separated as follows.

Key to genera and species of the subfamily Forficulinæ.

a^1. Fourth segment of antenna less than twice as long as broad; forceps of the male conspicuously depressed anteriorly across the base, and much broadened. *Forficula* Linnæus.

b^1. Forceps of the male no longer than the abdomen beyond the tips of the elytra and strongly bowed..... *F. auricularia* Linnæus.

b^2. Forceps of the male longer than the abdomen beyond the tips of the elytra and less strongly bowed..... *F. auricularia* var. *forcipata* Stephens.

a^2. Fourth segment of antennæ twice as long as broad; forceps of the male less depressed basally, and then only on the inner margin, and less broadened..... *Doru* Burr.

b^1. Wings projecting beyond the tips of the elytra.

c^1. Forceps of the male with an inner tooth in the apical third.

d^1. Larger and stouter, extreme length of male, including the forceps, more than 14 mm. and the greatest width of the abdomen usually more than 2.5 mm..... *D. linearis* Escholtz.

d^2. Smaller and more slender, extreme length of male, including the forceps, no more than 14 mm. and the greatest width of the abdomen usually no more than 2.5 mm..... *D. linearis* var. *exilis* Scudder.

c^2. Forceps of the male without an inner tooth in the apical third.

d^1. Larger and stouter, extreme length of male, including the forceps, more than 14 mm. and the greatest width of the abdomen usually more than 2.5 mm..... *D. linearis* var. *californica* Dohrn.

d^2. Smaller and more slender, extreme length of male, including the forceps, no more than 14 mm. and the greatest width of the abdomen usually no more than 2.5 mm..... *D. linearis* var. *exilis* Scudder.

b^2. Wings not projecting beyond the tips of the elytra..... *D. lutcipennis* Serville.

The cosmopolitan species *Forficula auricularia* has long been recorded as occurring in nearctic America, but there seems to be very few specimens in collections. There are seven specimens, one male and six females, in the Scudder collection labeled as from New York, from the Uhler collection. It doubtlessly occurs in our fauna sufficiently prevalent to warrant it a place in the catalogue, but the

Digitized by Google

variety *forcipata* has been reported but once from within our borders and then as an accidental importation.

The members of the genus *Doru* (= *Apterygida* and *Sphingolabis* authors not Westwood and Bormans) are represented by two species, *linearis* and *luteipennis*. *D. exilis* of Scudder I have reduced to varietal rank and *luteipennis* of Serville may eventually prove to be but a form of that species, but the absence of the wing scale makes so easy its separation that I have chosen to include it as specifically distinct. *D. californica* Dohrn scarcely deserves listing as of varietal distinctness as the presence or absence of inner teeth of the forceps of the male seems to mean very little. The same variation also occurs in the smaller and more slender *exilis*, but no name has ever been assigned to it. *D. exilis* is but a small form of *linearis* and shows no structures of specific importance.

Of the subfamily Chelisochinæ we have but one genus, *Chelisoches* of Scudder, which contains a single species recorded from our country, the *C. morio* of Fabricius, a large black earwig found in California.

The subfamily Labiinæ is represented in nearctic America by four genera, which may be separated as follows.

Key to the genera of the subfamily Labiinæ.

a^1. Cheeks, as viewed from above, as long as, or longer than, the eyes (fig. 3).

b^1. Fourth antennal segment cylindrical and as long as the third segment (fig. 2); size small, rarely over 7 mm. in length including the forceps...*Labia* Leach.

b^2. Fourth antennal segment more or less conical and distinctly shorter than the third segment (fig. 4); size larger, rarely, if ever, less than 8 mm. in length including the forceps.

c^1. Smaller, entire length, including forceps, rarely over 10 mm.; eyes smaller, scarcely as long as the basal segment of the antennæ.....*Prolabia* Burr.

c^2. Larger, entire length, including forceps, rarely less than 11 mm.; eyes larger, about as long as the basal segment of the antenna.....*Spongovostox* Burr.

a^2. Cheeks, as viewed from above, shorter than the eyes (fig. 5).....*Vostox* Burr.

FIG. 3.—HEAD OF LABIA FROM ABOVE, SHOWING LENGTH OF CHEEKS BEHIND THE EYES.

FIG. 4.—BASAL PORTION OF ANTENNA OF PROLABIA, SHOWING RELATIVE STRUCTURE OF THE SEGMENTS.

FIG. 5.—HEAD OF VOSTOX FROM ABOVE, SHOWING THE LENGTH OF THE CHEEKS BEHIND THE EYES.

These genera are closely related, *Prolabia* and *Spongovostox* indeed being scarcely separable from species found in our fauna except by the uniformly larger size of the latter. *Labia* is very distinct from all the others by the long cylindrical shape of the fourth segment of the antennæ and also by the minute size. *Vostox* agrees with *Pro-*

Digitized by Google

labia and *Spongovostox* in the character of the shorter subconical fourth segment of the antennæ but the shorter cheeks and longer eyes will serve to distinguish it.

Labia, as represented in our fauna, contains two species, *L. minor* Linnæus, and *L. curvicauda* Motschulsky. This last is a cosmopolitan species just recently recorded from within our boundaries, a number having been taken in Florida by Mr. Hebard, of Philadelphia. Like *L. minor*, also a cosmopolitan species but occurring widely distributed in the United States, *curvicauda* is a minute species but is easily distinguished from its ally by the decidedly more curved forceps of the male and by the last ventral segment of the abdomen being unarmed in both sexes while in the male of *minor* it bears a backward projecting tooth. The females of these two species are harder to separate but the unicolorously yellow brown legs of *minor* are quite distinct from those of *curvicauda*, which are darker basally or more or less infuscated all over.

Prolabia contains two distinct species found in the United States. They may be separated by the following key.

Key to species of genus Prolabia.

a^1. Wings not projecting beyond the tips of the elytra.

b^1. Segments of the apical half of the antennæ strongly clavate, the sides nearly straight; last ventral segment of male three times as broad as long, the pygidium of the same sex tapering posteriorly.....*arachidis* Yersin.

b^2. Segments of the apical half of the antennæ fusciform; last ventral segment of the abdomen of the male no more than twice as broad as long, the pygidium of same sex quadrate.....*unidentata* var. *burgessi* Scudder.

a^2. Wings projecting beyond the tips of the elytra.....*unidentata* Beauvois.

Prolabia arachidis Yersin is a cosmopolitan species recorded a number of times from just south of the United States but never yet reported north of Mexico except once under the name *Labia burgessi* by Samuel Henshaw.[1] Besides specimens from the lot on which this record of Henshaw was based, the United States National Museum contains one male taken from a ship at San Francisco, California, which had recently arrived from India, and also a pair from a lot of specimens taken by Prof. A. P. Morse in a slaughterhouse in Brighton, Massachusetts, on February 1, 1909. Recently a single female of this species was sent to the United States National Museum by G. N. Collins, who collected it at Aiken, Florida, in May, 1908.

The *Labia brunnea* of Scudder is here sunk in synonymy under *arachidis* Yersin. Types of *brunnea* have been examined and found to differ in no essential character from specimens of *arachidis* from Mexico named by Burr or the above-mentioned male from California, also named by Burr as *arachidis*. *Brunnea* is evidently unknown to

[1] Psyche, vol. 9, 1900, p. 119.

Digitized by Google

Burr, as he lists it in the genus *Labia* in his fascicule of Genera Insectorum. It belongs, however, to *Prolabia* and is a synonym of *arachidis*, as stated above.

Prolabia unidentata Beauvois includes as synonyms the *Labia guttata* and *melancholica* of Scudder and the *Forficula pulchella* of Serville. *Prolabia burgessi* Scudder, first relegated to varietal rank under *unidentata* by Burr, is superficially like *arachidis* but is structurally quite different, as indicated in the foregoing key.

FIG. 6.—METASTERNUM OF LABIDURA, SHOWING THE POSTERIOR WIDTH AS COMPARED WITH THAT OF THE HIND COXA.

The genus *Spongovostox* is represented in our fauna by the single species *apicidenta* Caudell, described as a *Spongiphora*.

Vostox Burr is represented in nearctic America by the type-species, the *Spongiphora brunneipennis* of Serville.

The fourth subfamily as represented in our fauna contains three genera, *Psalis* Serville, *Labidura* Leach, and *Anisolabis* Fieber. The characters given in the following key will serve to separate them.

Key to genera of subfamily Labidurinæ.

a^1. Metasternum at posterior margin almost or quite, often more than, twice as broad as the width of one of the hind coxæ (fig. 6).

b^1. With both elytra and wings; cheeks behind the eyes, as viewed from above, no longer than the eyes; sixth joint of antennæ generally no longer than broad.....*Labidura* Leach.

b^2. With neither elytra nor wings; cheeks behind the eyes, as viewed from above, a little longer than the eyes; sixth joint of antennæ generally a little longer than broad.....*Anisolabia* Fieber.

a^2. Metasternum at posterior margin but little, if any, broader than the width of one of the hind coxæ (fig. 7).....*Psalis* Serville.

Of the above genera, *Labidura* and *Psalis* are each represented in our fauna by a single species. The other genus, *Anisolabis*, contains two species found within our boundaries, both cosmopolitan, one, *A. maritima* Géné, being found only along the seashore. The second species of *Anisolabis*, *A. annulipes* Lucas, is often found quite a distance from the coast. It has one or two of the segments in the apical portion of the antennæ whitish and almost always has the femora banded with blackish. These characters will serve to distinguish it from *maritima*, which has the femora and antennæ unicolorous.

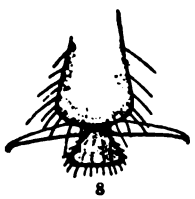
FIG. 7.—METASTERNUM OF PSALIS, SHOWING THE POSTERIOR WIDTH AS COMPARED WITH THAT OF THE HIND COXA.

Psalis percheroni Guerin and Percheron is the only representative of the genus *Psalis* from the United States. It was recorded from a single specimen taken many years ago in Massachusetts by Harris. This specimen, now lost, was an accidental introduction, and so the species is not really eligible for entrance in our lists except as a casual visitor.

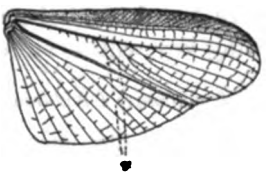
Digitized by Google

Family BLATTIDÆ.

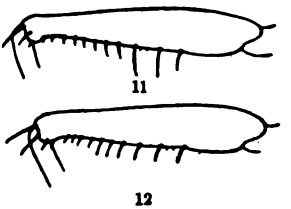
As regards subfamily division the Blattidæ is indeed the most difficult family of Orthoptera with which the systematist has to deal. Many of the characters used for the separation of the roaches into the dozen or more subfamilies into which they are usually divided are secondary sexual in nature, are not consistently correlative, or are otherwise unsatisfactory. Eleven subfamilies are usally recognized by students of the Blattidæ, but Kirby recognizes 16 in his Synonymic Catalogue of Orthoptera. Scudder considered the nearctic forms as catalogued by him as comprising seven families. I have united Periplanetinæ with Blattinæ, their distinguishing feature being a secondary sexual character. The late Mr. Shelford, of England, an authority on this group, inaugurated this change some months ago.



8



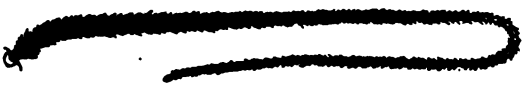
10



11

12

9



13

FIG. 8.—CLAWS OF EURYCOTIS, SHOWING THE AROLIA BETWEEN THEM.
FIG. 9.—PRONOTAL DISK OF PHYLLODROMICA, SHOWING COLORATION.
FIG. 10.—WING OF ISCHNOPTERA, SHOWING VENATION. *v*—INCOMPLETE BRANCHES OF THE ULNAR VEIN.
FIG. 11.—FORE FEMORA OF BLATTELLA, SHOWING VENTRAL ARMATURE.
FIG. 12.—FORE FEMORA OF SUPELLA, SHOWING VENTRAL ARMATURE.
FIG. 13.—ANTENNÆ OF PSEUDOMOPS, SHOWING BASAL SWELLING.

The seven subfamilies into which I consider the nearctic Blattidæ as falling may be separated by the following key.

Key to subfamilies of nearctic Blattidæ.

a^1. Middle and hind femora armed beneath along one or both margins with two or more distinct spines.
  b^1. Pronotum and elytra densely covered with microscopic silky pile. NYCTOBORINÆ.
  b^2. Pronotum and elytra smooth, or but sparsely haired or pilose ..... BLATTINÆ.
a^2. Middle or hind femora, or both, unarmed beneath, or armed with hairs or bristles only, or with one or two apical or subapical spines on one or both margins.
  b^1. Claws separated by a distinct arolium (fig. 8).
    c^1. Wings provided with a distinct apical field ..... PLECTOPTERINÆ.
    c^2. Apterous, or the wings without or with an indistinct apical field. PANCHLORINÆ.
  b^2. No arolium between the claws, or only a minute one.
    c^1. Anal field of the wing with a single fold, or apterous with the pronotum more or less pilose or hairy ..... CORYDINÆ.

Digitized by Google

c^2. Anal field of the wing with two or more folds, or apterous with the pronotum smooth.

d^1. Supraanal plate of both sexes apically notched.....BLABERINÆ.

d^2. Supraanal plate of both sexes apically entire.....PANESTHINÆ.

The subfamily Nyctoborinæ is represented with us by two genera, the first, *Attaphila* Wheeler, comprising only the minute myrmecophilous species *fungicola* Wheeler from Texas, and the second, *Nyctobora* Burmeister, a genus of very large roaches, of which three species have been recorded from within our boundaries, all three being introductions.

Of the subfamily Blattinæ we have several genera, which may be distinguished by the following superficial key.[1]

Key to genera of subfamily Blattinæ.

a^1. Larger, the pronotum 7 mm. or more in length.

b^1. Elytra extending nearly or entirely to the tip of the abdomen.

c^1. Elytra extending considerably beyond the tip of the abdomen. *Periplaneta* Burmeister.

c^2. Elytra not or barely exceeding the tip of the abdomen..*Pelmatosilpha* Dohrn.

b^1. Elytra falling considerably short of the tip of the abdomen.

c^1. Pronotum uniformly black.

d^1. Arolia small, less than one-half as long as the claws.....*Blatta* Linnæus.

d^2. Arolia large, fully one-half as long as the claws.....*Eurycotis* Stål.

c^2. Pronotum with yellowish markings.....*Blatta* Linnæus.

a^2. Smaller, the pronotum less than 7 mm. in length.

b^1. Antennæ setaceous, sparsely pilose.

c^1. Elytra of the male extending beyond the tip of the abdomen; subgenital plate of the female entire.

d^1. Small, entire length no more than 8 mm.

e^1. Elytra of female falling much short of the tip of the abdomen. *Ischnoptera* Burmeister.

e^2. Elytra of both sexes extending nearly or quite to the tip of the abdomen. *Ceratinoptera* Brunner.

d^2. Larger, entire length more than 8 mm.

e^1. Disk of pronotum shiny black with a bright yellow stripe bounding it, this stripe being marginal laterally and separated from the edge narrowly in front and broadly behind (fig. 9).....*Phyllodromica* Fieber.

e^2. Disk of pronotum not as above.

f^1. Posterior ulnar vein of wing with some of the branches incomplete or ending in the dividing vein (fig. 10).

g^1. Cerci extending distinctly more than one-half its own length beyond the tip of the supra-anal plate.....*Ischnoptera* Burmeister.

g^2. Cerci not extending distinctly more than half its own length beyond the tip of the supra-anal plate.....*Phœtalia* Stål.

f^2. Posterior ulnar vein of wing simple, or with all the branches extending to the apex of the wing, or the vein connected to the dividing vein by parallel cross veins.

g^1. Anterior inferior margin of the fore femora armed on the basal half with from three to five or six strong spines succeeded distally by a row of smaller close-set spinules (fig. 11); elytra of nearctic forms unicolorous.....*Blattella* Caudell.

[1] *Eptlampra* does not appear in this table. It is known in our fauna by a single unnamed specimen, a male from New Jersey, in the collection of the Academy of Natural Sciences in Philadelphia.

Digitized by Google

g^2. Anterior inferior margin of fore femora armed along its entire length with stout spines which diminish in length toward the apex (fig. 12); elytra distinctly marked with black.....*Supella* Shelford.

c^2. Elytra of male falling distinctly short of the tip of the abdomen; subgenital plate of the female fissate.....*Blatta* Linnæus.

b^2. Antennæ basally incrassate and densely pilose (fig. 13)....*Pseudomops* Serville.

The three species of *Periplaneta* represented in our fauna are separable by the characters given in the following tables, one table based on the males and one on the females.

Key to male species of genus Periplaneta.

a^1. Supraanal plate produced considerably beyond the subgenital plate, apically rounded and deeply notched.....*americana* Linnæus.

a^2. Supraanal plate not or scarcely produced beyond the subgenital plate, apically truncate and not deeply notched.

b^1. Elytra marked by a yellow humeral spripe, in distinct contrast to the color of the rest of the elytra.....*australasiæ* Fabricius.

b^2. Elytra without a distinct yellow humeral stripe.....*brunnea* Burmeister.

Key to female species of genus Periplaneta.

a^1. Elytra marked by a yellow humeral stripe, in distinct contrast to the color of the rest of the elytra.....*australasiæ* Fabricius.

a^2. Elytra without a distinct yellow humeral stripe.

b^1. Cerci with all the segments except the last one or two quadrate or transverse, the whole cercus tapering from near the middle (fig. 14); pronotum usually uniformly shiny blackish brown, rarely with paler mottling.*brunnea* Burmeister.

b^2. Cerci with several of the apical segments longer than broad, the whole cercus tapering from about the base; pronotum always with paler mottlings (fig. 15).....*americana* Linnæus.

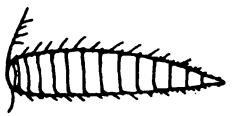


FIG. 14.—CERCI OF PERIPLANETA BRUNNEA, FEMALE.

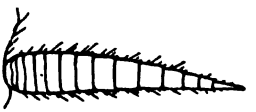


FIG. 15.—CERCI OF PERIPLANETA AMERICANA, FEMALE.

Pelmatosilpha rotundata Scudder is the only member of that genus found in our fauna.

Besides the common black roach of the house, *Blatta orientalis* Linnæus, we have one other member of this genus within our borders, *Blatta rhombifolia* of Stoll having been found in Arizona. The variegated thorax of the latter species, together with the lateral elytra of the males, will serve to separate it at a glance from the well-known house species. The genus *Neostylopyga* Shelford is a synonym of *Blatta* Linnæus, the species upon which it is based belonging to *Blatta* as shown by me.[1]

Of *Ischnoptera* we have several species. This genus has been recently revised by Rehn and Hebard.

[1] Psyche, vol. 18, 1912, p. 89.

Digitized by Google

Ceratinoptera Brunner is represented by two species, *diaphna* Fabricius and *lutea* Saussure and Zehntner. *Diaphana* is distinguishable from *lutea* by having an undulating black stripe extending longitudinally across each half of the pronotum and extending back over the elytra.

Phyllodromica Fieber contains a single North American species, *P. abortiva* Caudell, described some years ago from Texas as *Anaplecta abortiva*.

Blatella Caudell contains three species recorded from North America north of Mexico. The type, *germanica* Linnæus, is easily distinguishable from the other species by the disk of the pronotum, which is marked by two longitudinal parallel black stripes. The other two species, *dilatata* Saussure and *adspersicollis* Stål, both occur in our Southern States only, so far as reported, while *germanica* is a household pest nearly everywhere. Lack of sufficient authentic material of *B. dilatata* renders it inadvisable at this time to give diagnostic characters for the separation of this species from *adspersicollis*. The females can be distinguished by the length of the wings, which are not or scarcely longer than the abdomen in *dilatata* and considerably exceeding it in *adspersicollis*.[1]

FIG. 16.—PRONOTAL DISK OF PSEUDOMOPS CINCTA, SHOWING COLORATION.

Supella Shelford, based on the single species *Blatta supellectilium* of Serville, has as the main differentiating character the armature of the anterior inferior margin of the fore femora, a very unsatisfactory character, as fully set forth by Saussure and Zehntner.[2]

Pseudomops contains two species found with us, *P. cincta* Burmeister and *P. intercepta* Burmeister. The latter is what has been recorded in our fauna as *oblongata*. Shelford separates these two United States species as follows.

Key to species of genus Pseudomops.

a^1. Ground color of promotum fuscous, the lateral yellow margin not inwardly produced (fig. 16) ..... *cincta* Burmeister.

a^2. Ground color of pronotum some shade of rufous, the lateral pale border produced inwardly ..... *intercepta* Burmeister.

Phœtalia lævigata Palisot, the only nearctic representative of that genus, has as synonyms *Nauphota pallida* Brunner and *N. marginalis* Walker. Kirby catalogues *N. pallada* Brunner as distinct from *lævigata* Palisot, placing Palisot's species in the genus *Leucophœa* with

[1] Mr. Shelford has made this species the type of a new genus, which he calls *Neoblattella*. The only characters mentioned as different from *Blattella* are the ramose ulnar vein of the wing and the anterior portion of the wing being broader, especially apically, This last character is good for the separation of the respective type species of these two genera, but does not separate other species of *Blattella* from *adspersicollis*, some species indeed falling in this respect nearly intermediate between *germanica* and that species. Also, I find considerable variation in the branching of the ulnar vein, even in different specimens of the same species. The examination of a very few specimens shows a variation of from three to five branching in *adspersicollis* and from simple to two branching in *germanica*. I therefore consider *Neoblattella* a synonym of *Blattella*.

[2] Biol. Cent.-Amer., Orth., vol. 1, 1893, p. 30.

Digitized by Google

a query. But from a study of several specimens from West Indies and South and Central America and Teneriff together with the figure of Palisot and the description of Brunner I agree with the late Mr. Shelford in considering these synonymous. I follow Kirby in placing the *N. marginalis* of Walker in the synonymy under this species. The measurements of *marginalis* would seem to preclude its inclusion here, but Kirby should be able to judge this matter properly, having Walker's types for comparison.

The other genera of this subfamily are represented in our fauna by one or two species each, all from our Southern States. *Eurycotis fischiana* Saussure is worthy of a place in the list only as a visitant, if at all, being recorded only from a single nymph introduced and one questionably identified as that species.

Two genera belonging to the subfamily Plectopterinæ are found in the United States, *Chorisoneura* Brunner and *Plectoptera* Saussure. The former is distinguished by having the elytra very little convex and with a distinct anal sulcus. Each of these genera are represented with us by two species. *Chorisoneura texensis* Saussure and Zehntner is smaller than *C. plocea* Rehn, being less than 10 mm. in total length. *Plectoptera picta* Saussure and Zehntner is known in the United States by a single specimen in the United States National Museum labeled "Va." The large black discal spot of the pronotum of this species will readily separate it from *P. poeyi* Saussure.

We have several genera of the subfamily Panchlorinæ separable as follows.

Key to nearctic genera of the subfamily Panchlorinæ.

a^1. Basal segment of hind tarsi naked beneath.
  b^1. Posterior femora with an apical spine beneath on both margins. *Pycnoscelus* Scudder.
  b^2. Posterior femora with an apical spine beneath on one margin only or on neither margin.
    c^1. Wings and elytra surpassing the tip of the abdomen..... *Leucophæa* Brunner.
    c^2. Wings abortive, elytra about half as long as the pronotum, covering scarcely more than one half of the abdomen..... *Hormetica* Burmeister.
a^2. Basal segment of the hind tarsi hairy beneath.
  b^1. Small, the entire length less than 10 mm..... *Holocompsa* Burmeister.
  b^2. Larger, the entire length 10 mm. or more..... *Panchlora* Burmeister.

Each of the above genera are represented in our fauna by a single species except *Panchlora*, of which several species have been reported from the United States and Canada, most of them introductions, as indeed are many of our roaches. The species of *Panchlora* are in a state of chaos and the genus is in dire need of revision.

Our only species of *Holocompsa*, *H. collaris* Burmeister, has arolia between the claws and is therefore placed in this subfamily.

The subfamily Corydinæ contains three North American genera separable as follows.

Digitized by Google

Key to genera of subfamily Corydinæ.

a^1. Anterior tibiæ not or but little more than three times as long as the greatest width, apically conspicuously swollen; larger forms, the pronotum 3, or more mm. in length.

b^1. Posterior tibiæ with six apical spurs and armed beneath with 4–6 spines and with short pile; abdomen naked beneath.....*Arenivaga* Rehn.

b^2. Posterior tibiæ with seven apical spurs and armed beneath with but two spines on the apical fifth and with fine long hairs; abdomen hairy beneath.
Eremoblatta Rehn.

a^2. Anterior tibiæ five or six times longer than the greatest width, apically very little swollen; smaller forms, the pronotum no more than 2 mm. in length
Latindia Stål.

Arenivaga and *Eremoblatta* were established as subgenera of *Homeogamia*, and the species pertaining to them, except a few varietal forms described since, are reviewed by Mr. J. A. G. Rehn.[1] The third genus, *Latindia*, is represented with us by the single species *L. schwarzi* Caudell.

Of the subfamilies Blaberinæ and Panesthinæ we have one genus each, *Blaberus* Serville and *Cryptocercus* Scudder, the former having long wings while the second has neither wings nor elytra. *Cryptocercus* contains the single species *C. punctulatus* Scudder, but there are two species of *Blaberus* which have been taken in our confines. These two species may be distinguished by *atropos* having the large discal spot of the pronotum reaching the posterior margin, while in *cubensis* it does not reach the posterior margin. *Atropos* seems eligible to a place in the list of nearctic Blattidæ, but *cubensis* is but a transient visitor, a single specimen being known from our borders, a single female from New York, very surely an accidental importation. The specimen recorded in 1910 by Mr. Rehn[2] as this species has proved to be an *atropos*.

Family MANTIDÆ.

Representatives of three of the six subfamilies of the Mantidæ are found within the borders of the United States. As represented with us these may be separated by the following key.

Key to subfamilies of nearctic Mantidæ.

a^1. Head unarmed; middle and hind tibiæ rounded above.

b^1. Pronotum at least twice and usually three or more times as long as broad and noticeably broadened at the point of insertion of the coxæ (figs. 17 and 23).
MANTINÆ.

b^2. Pronotum subquadrate, but little longer than broad and the sides parallel (fig 18).
EREMIAPHILINÆ.

a^2. Head armed with a pair of long processes, as long as the head itself; middle and hind tibiæ carinate above.....VATINÆ.

[1] Proc. Acad. Nat. Sci. Phila., 1903, pp. 177–192.
[2] Ent. News, vol. 21, p. 108.

Digitized by Google

By far the greater proportion of the nearctic Mantidæ belong to the first subfamily as defined above. The dozen genera comprising this subfamily in our fauna may be for the most part easily separated by the following key, which is based partially on purely superficial characters.

Key to genera of subfamily Mantinæ.

a^1. Eyes rounded (obtusely conical in *Litaneutria*) (fig. 19), insects varying in size and, except the females of *Thesprotia* and *Bactromantis*, all with more or less well-developed wings.

b^1. Inner margin of the upper surface of the extended anterior coxæ not conspicuously dilated apically (fig. 20).

c^1. Pronotum not or but little longer than the anterior coxæ.

Litaneutria Saussure.

c^2. Pronotum considerably longer than the anterior coxæ.

d^1. Antennæ filiform.

e^1. Broadest portion of the pronotum far in advance of the middle, the width again diminishing anterior of the broadest point (fig. 17).

f^1. Larger, pronotum more than 10 mm. in length.

g^1. Pronotum of the female scarcely longer than the elytra.

h^1. Facial shields distinctly more than twice as broad as high in both sexes, in the male about three times as broad (fig. 24).

Stagmomantis Saussure.

h^2. Facial shield of neither sex scarcely more than twice as broad as high (fig. 25).

i^1. Inner surface of fore coxæ ornamented on the basal third with a large oval piceous spot ..... *Mantis* Linnæus.

i^2. Inner surface of fore coxæ not ornamented as above.

Paratenodera Rehn.

g^2. Pronotum of the female decidedly longer than the elytra.

Phasmomantis Saussure.

f^2. Smaller, the pronotum no more than 10 mm. in length.

Callimantis Stål.

e^2. Broadest portion of the pronotum beginning at about the middle and from there to the apex almost or quite parallel (fig. 23)... *Gonatista* Saussure.

d^2. Antennæ distinctly swollen just beyond the base (fig. 22).

Brunneria Saussure.

b^2. Inner margin of the upper surface of the extended anterior coxæ abruptly and considerably elevated apically (fig. 21).

c^1. Anterior tibiæ longer than their apical claw.

d^1. Fore and hind sections of the pronotum subequal in length.

Oligonyx Saussure.

d^2. Hind section of the pronotum about twice as long as the fore section.

Bactromantis Scudder.

c^2. Anterior tibiæ no longer than the apical claw..... *Thesprotia* Scudder.

a^2. Eyes produced and acutely conical (fig. 26); insects of small size, seldom over an inch long, and entirely wingless..... *Yersinia* Saussure.

Several years ago[1] I gave a table of the species of the genus *Litaneutria*. That key was not very satisfactory but it was the best I could do then and I can do no better now. Since that time one new species has been described, the *L. skinneri* of Rehn, characterized by the abbreviated organs of flight of the males. It is possible that

[1] Proc. U. S. Nat. Mus., vol. 28, 1905, p. 463.

Digitized by Google

the males of this genus are dimorphic in wing length and that most or all the species will be found with short-winged males, though such conditions are uncommon in the Mantidæ. *Skinneri* was described from Arizona but has since been recorded from Texas, New Mexico, and California and also occurs in Colorado and Nebraska. It may prove to be the brachypterous form of an older species if the males of these insects do prove to be dimorphic in wing length.

Since Scudder's catalogue appeared there have been two species of the genus *Stagmomantis* described, *S. gracilipes* Rehn, from Arizona, and *S. californica* Rehn and Hebard from California. The former I do not know, the type, a single male, being in the Snow collection in Kansas. It seems closely allied to *limbata*. Of what I consider as *S. californica* I have one male from Oil Center, California, one pair

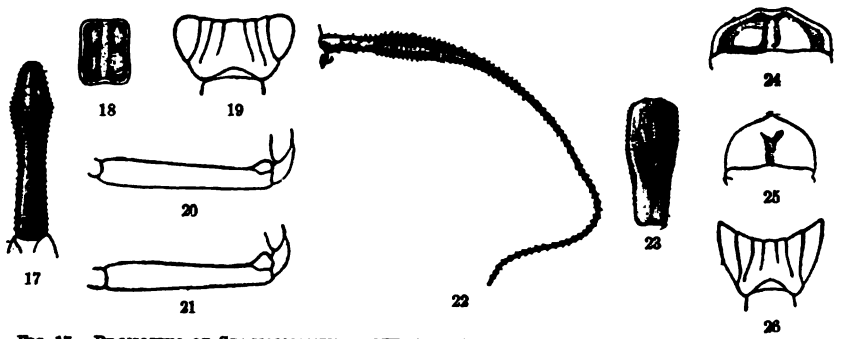


FIG. 17.—PRONOTUM OF STAGMOMANTIS, SHOWING SHAPE.
FIG. 18.—PRONOTUM OF MANTOIDA, SHOWING SHAPE.
FIG. 19.—HEAD OF LITANEUTRIA, SHOWING SHAPE OF EYES.
FIG. 20.—EXTENDED ANTERIOR COXA OF LITANEUTRIA, SHOWING THE ROUNDED SWELLING OF THE DISTAL END OF THE INNER DORSAL MARGIN.
FIG. 21.—EXTENDED ANTERIOR COXA OF OLIGONYX, SHOWING THE MORE PROMINENT AND ABRUPT SWELLING OF THE DISTAL END OF THE INNER DROSAL MARGIN.
FIG. 22.—ANTENNA OF BRUNNEA, SHOWING THE BASAL SWELLING.
FIG. 23.—PROMOTUM OF GONATISTA, SHOWING SHAPE.
FIG. 24.—FACIAL SHIELD OF STAGMOMANTIS, SHOWING WIDTH AS COMPARED WITH THE HEIGHT.
FIG. 25.—FACIAL SHIELD OF MANTIS, SHOWING WIDTH AS COMPARED WITH THE HEIGHT.
FIG. 26.—HEAD OF YERSINIA, SHOWING SHAPE OF THE EYES.

from Golden Roads, Arizona, one female from Rhyolite, Nevada, one male from Las Cruces, New Mexico, and one female from El Paso, Texas.

Probably all of the species of this genus come in both green and brown colored forms. The typical color of the common eastern species, *S. carolina*, is brown, the green form bearing the name *irrorata* of Linnæus.

The three species known to me and belonging to our fauna may be separated as follows.

Key to species of genus Stagmomantis.

a^1. Abdomen dorsally uniform, or almost uniform in coloration.
b^1. Costal area of the elytra of the male transparent, or nearly so; costal area of the elytra of the female tapering from near the base.....*carolina* Linnæus.

Digitized by Google

b^2. Costal area of the elytra of the male coriaceous and opaque; costal area of the elytra of the female with the margins subparallel to near the distal end.
limbata Hahn.

a^2. Basal three or four segments of the abdomen conspicuously marked transversely above on the posterior fourth or more with black or dark brown.
californica Rehn and Hebard.

Phasmomantis sumichrasti Saussure does not appear very well established as a nearctic form as it seems never to have been recorded from our region except one time, by Saussure and Zehntner from a specimen in the Museum at Geneva.

I consider *Oligonyx uhleri* Stål a variety of *O. scudderi* Saussure, the only essential difference seeming to be the hyaline wings and elytra of *scudderi* as compared with the infuscated ones of *uhleri*. A single male specimen of *uhleri* is in the collection of the National Museum.

A female specimen of *Thesprotia graminis* in the collection of the United States National Museum, is labeled as coming from New York. This must be an accidental occurrence.

The subfamily Eremiaphilinæ is represented by a single genus and species found in our region, the *Mantoida maya* of Saussure and Zehntner, having been recorded from Florida.

Two genera of the subfamily Vatinæ occur in our fauna. The posterior tibiæ of *Vates* Burmeister being furnished with foliations will serve to separate that genus from *Phyllovates* Kirby, where they are simple. *Phyllovates* is represented with us by the single species *chlorophæa* Blanchard, a rare species listed by Scudder as *Theoclytes chlorophæa* and recorded from the Gulf States and by accident from New York. *Vates* contains two species recorded from the United States, both from Arizona. These are *V. paraensis* Saussure and *V. townsendi* Rehn. These two species may be best distinguished by the costal area of the elytra of the female which is abruptly tapered near the apex in *townsendi* and gradually tapered from near the base in *paraensis*. Both are very rare species in our fauna.

Family PHASMIDÆ.

The Phasmidæ of nearctic America were revised by the writer a few years ago, but since that date several new genera and species have been described which necessitates new keys for the separation of certain genera and species. Five of the fifteen subfamilies of Phasmidæ are represented in our fauna. They may be easily separated by the following key.

Key to subfamilies of nearctic Phasmidæ.

a^1. Tarsi five jointed; not small earwig-like creatures with the cerci of the male forcep-like.

b^1. Mesothorax four or more times as long as the prothorax; hind and middle tibiæ carinate ventrally to the tip, without an apical areolate area.

c^1. Median segment not or barely longer than broad; apterous.

Digitized by Google

d^1. Antennæ longer than the fore femora.....BACUNCULINÆ.
d^2. Antennæ shorter than the fore femora.....CLITUMNINÆ.
c^2. Median segment distinctly longer than the width; adults with short elytra and wings.....PHIBALOSOMINÆ.
b^2. Mesothorax never more than three times as long as the prothorax, generally less; hind and middle tibiæ furnished beneath apically with a sunken areolate area.....ANISOMORPHINÆ.
a^2. Tarsi three jointed; small earwig-like creatures with the cerci of the male forceps-like.....TIMEMINÆ.

The first of these subfamilies, Bacunculinæ, includes several genera comprising far more species than all the other four subfamilies taken together. The nearctic american genera falling into this subfamily are separable as follows.

Key to genera of subfamily Bacunculinæ.

a^1. Head subquadrate or cylindrical, usually distinctly longer than broad, attached obliquely or horizontally; small or moderate sized species with the hind femora not armed as in the alternate; cerci of the male not spatulate.
b^1. Posterior femora of both sexes armed beneath with a prominent subapical spine, often quite small in the female; middle femora of the male generally distinctly thicker than the hind ones.
c^1. Head unarmed.....*Diapheromera* Gray.
c^2. Head armed with a pair of small horns....*Rhabdoceratites* Rehn and Hebard.
b^2. Posterior femora of both sexes without a prominent subapical spine beneath; middle femora of male usually not or but little thicker than the hind ones.
c^1. Head unarmed above.
d^1. Cerci of male simple; head smooth, antennæ more than twice as long as the anterior femora.
e^1. Middle femora armed beneath with a distinct subapical spine. *Manomera* Rehn.
e^2. Middle femora without a distinct subapical spine beneath. *Heteronemia* Gray.
d^2. Cerci of male apically trifid; head carinate or longitudinally rugose between the eyes; antennæ usually less than twice as long as the anterior femora. *Pseudoseymyle* Caudell.
c^2. Head armed above with a pair of horns or leaf-like appendages. *Hoplolibethra* Caudell.
a^2. Head ovate, short, scarcely longer than broad; attached subvertically; cerci of male broadly spatulate; very large species with the hind femora armed beneath for entire length with a median row of strong spine.....*Megaphasma* Caudell.

The genus, *Diapheromera*, contains several species which are more or less closely allied, and, especially in the female, often difficult to separate. The females divide into two groups, one with the cerci scarcely more than one-half as long as the eighth abdominal segment, and the other with the cerci decidedly more than one-half as long as that segment. The first group consists of *femorata* Say and *arizonensis* Caudell, the first with the operculum arcuate apically, while in the second that organ is arcuate truncate, with a distinct median projecting finger. The second group contains the rest of the species,

Digitized by Google

which in this sex are hard to separate diagnostically, and more material and study is necessary for the preparation of a key to separate them on this sex alone. The following key, based mostly on the males, will prove of help in the determination of these walking sticks.

Key to males of genus Diapheromera.

a^1. Cerci incurved.
  b^1. Cerci cylindrical, with a basal tooth or tubercle.
    c^1. Cerci with an acute and slender basal tooth.
      d^1. Ninth segment of the abdomen scarcely longer than the greatest width. *velii* Walsh.
      d^2. Ninth abdominal segment distinctly longer than the greatest width. *persimilis* Caudell.
    c^2. Cerci with a blunt basal tooth or tubercle.
      d^1. Seventh and ninth segments of the abdomen subequal in length.
        e^1. Ninth segment of the abdomen distinctly longer than the greatest width; inner ventro-lateral carina of the hind femora with very minute serrations; cerci of the female as long as the eighth segment of the abdomen. *persimilis* Caudell.
        e^2. Ninth segment of the abdomen scarcely or no longer than the greatest width; inner ventro-lateral carina of the posterior femora smooth; cerci of the female about one-half as long as the eighth segment of the abdomen. *arizonensis* Caudell.
      d^2. Seventh segment of the abdomen distinctly longer than the ninth (cerci of female about one-half as long as the eighth segment of the abdomen.) *femorata* Say.
  b^2. Cerci strongly compressed, without any basal tooth or tubercle..*carolina* Scudder.
a^2. Cerci rigidly straight, or more or less curled in drying.....*mesillana* Scudder.

D. persimilis shows some considerable variation in the basal tooth of the cerci of the male. This is sometimes sharp, like in *velii*, and sometimes apparently nearly as blunt as in *femorata*. But the comparative lengths of the last segments of the abdomen of the male will separate it from *velii* or *femorata*, and the long cerci of the female prohibits it from being confused with the latter species.

I have two male specimens which I take to be *D. mesillana*. They are nymphs, and come from Victoria, Texas, and I have an adult male from Columbus, Texas. Specimens from Brownsville, Texas, are in the Museum of the Brooklyn Institute of Arts and Sciences, and in the Scudder collection I find a male from Kansas which I determine as this species. In this specimen from Kansas the cerci are not concave on the inner side, and it is doubtful if any are in life, as the cerci of female specimens of most species are naturally round when fresh but flatten out in drying. The cerci of the male of *mesillana* being straight, like that of the female of most species, is very likely naturally round. More investigation with fresh material is necessary to make this certain. If the cerci of this species are actually concave on the inner side, the round shape of those of this Kansas specimen must be attributed to the specimen being originally preserved in spirits, which it very clearly was.

Digitized by Google

The following notes on the male type of this species are copied from my notebook as written a few months ago: "The male type has the cerci convex outwardly and deeply concave inwardly. The ninth segment of the abdomen is about two times as long as broad, parallel sided, and posteriorly broadly notched, the entire length about equaling that of the cerci; eighth segment two-thirds as long as the ninth, of the same width posteriorly and broadening a little anteriorly; seventh segment about the same length as the ninth and of the same width posteriorly as the anterior width of the eighth segment, the anterior part gently narrowing. Middle femora not much longer than the hind ones. Spine of the hind femora small, but distinct."

The following notes on the unique male type of *D. carolina* are from my note book: "Cerci strongly incurved and much flattened, being fully twice as thick vertically as horizontally, broadened slightly toward the apex; outwardly the cerci are convex and inwardly, especially in the apical portion, concave, nearly spoon-shaped; no basal cercal tooth visible. Ninth segment of the abdomen globose no longer than the posterior width. Seventh and eighth segments of abdomen equal in length, each slightly broader than long and neither quite as long as the ninth segment."

The Scudder collection contains a pair of walking sticks which I consider as probably belonging here in which the cerci of the male are more concave inwardly than those of the type. The cerci of this female are as long as the eighth segment of the abdomen and concave on the inside. The eighth segment of the abdomen is apparently a fourth shorter than the ninth. These were evidently preserved in spirits and are considerably shriveled. They are labeled "Palmer Assorting No. 1032." This, according to a note book shown me by Mr. Henshaw, means "Pacific R. R. Survey near 38° L. Sb. E. Beckwith, U. W. A."

The genus *Rhabdoceratites* of Rehn and Hebard is closely allied to *Diapheromera*, but the head being armed with a small pair of horns, or spurs, will serve to separate it from that genus. The only species recorded from our fauna is *R. covillex* Rehn and Hebard, described in 1909 from Texas. In 1906 I took nymphs at Ciudad Juarez, Mexico, on creosote bushes, but failed to rear adults. The Scudder collection contains a female from New Mexico. About the middle of September, 1912, Mr. C. K. Gray sent to the United States National Museum a female of this species which had freshly matured, the old skin being but partially cast. A month later three pairs of this fine insect were received from the same gentleman, all being taken from creosote bushes at El Paso, Texas. The eggs of this species, a number of which were found in the box with the living insects, are very like those of *Diapheromera*, but appear to be more fragile and are decidedly

Digitized by Google

less elongate, the length being noticeably less than that of the eggs of *Diapheromera*, while the width and thickness are about the same.

Manomera Rehn and Hebard, made for *Bacunculus* as used by Scudder and the writer, contains three species, separable by the following table, which is based on the males, as the female of *orthostylus* is unknown.

Key to males of genus Manomera.

a^1. Middle femora not or scarcely thicker than the posterior ones.
  b^1. Cerci curved inward.....*tenuescens* Scudder.
  b^2. Cerci straight (fig. 27).....*orthostylus*, new species.
a^2. Middle femora distinctly thicker than the posterior ones.....*blatchleyi* Caudell.

The short and broader head of the female of *blatchleyi* will serve to separate it from *tenuescens*. The new species is described as follows:

MANOMERA ORTHOSTYLUS, new species.

Male (female unknown).—Similar to *tenuescens* Scudder, but readily distinguished from that species by the cerci of the male being straight instead of strongly incurved. The general color is brownish but is probably greenish in life. A lateral stripe runs across the head and thorax and onto the abdomen. Head, thorax, and abdomen smooth, the latter not inflated apically, all the segments being nearly or almost parallel sided; the ninth or apical segment is three times as long as broad, apically broadly and shallowly notched; eighth segment two-thirds as long as the ninth, twice as long as broad; seventh segment slightly longer than the eighth but not quite as long as the ninth. Operculum scarcely reaches the tip of the eighth segment. Cerci five or six times as long as the greatest width, tapering to a point and rounded, a little broader vertically than thick, usually flat in dried specimens, the whole not quite as long as the last abdominal segment. The legs are slender, the middle femora armed beneath with a subapical spine, the hind femora without such spine, both femora of approximately the same thickness.

FIG. 27.—TIP OF ABDOMEN OF MANOMERA ORTHOSTYLUS, SHOWING STRAIGHT CERCI.

Measurements.—Total length, 61 mm.; pronotum, 2 mm.; mesonotum, 14 mm.; fore femora, 16 mm.; middle femora, 12.5 mm.;[1] hind femora, 16 mm.; cerci, 1.5 mm.

Type.—One male (Cat. No. 15275, U.S.N.M.), Orlando, Florida, April 14, 1907, Mr. Russell collector.

A paratypical male from the Scudder collection, from Dallas, Texas, has been examined. Except for being a little smaller and with longer cerci, as long as apical segment of abdomen, it is essentially like the type. The operculum also surpasses the eighth abdominal segment. It measures as follows: Total length, 45 mm.; pronotum, 2 mm.; meso-

[1] The left middle leg is dwarfed, the femora measuring but 10 mm. in length.

Digitized by Google

notum, 10 mm.; fore femora, 12 mm.; middle femora, 9 mm.; hind femora, 11.5 mm.; cerci, 2 mm.

Under the genus *Bacunculus* Brunner has recorded three walking sticks as occurring in our fauna, two of which are unknown to the writer. One is the *Bacteria* (*Bacunculus*) *striatus* of Burmeister and the others are ones described by Brunner as new, all treated as species of *Bacunculus* but rightly referable to the older generic name *Heteronemia* of Gray. *Striatus* Burmeister is recorded from Texas, another, *texanus*, is described from the same State, while the third, *lævissimus*, is described from St. Louis and "Lacus Ontario." These last two are very probably synonyms of other species, but until the types are seen it is not deemed advisable to so place them. The last, *lævissimus*, is probably a young female, *Diapheromera femorata*. The three species are separated as follows by Brunner, the table based on the female:

Key to species described by Brunner.

a^1. Abdomen smooth.

b^1. Second and third segments of the abdomen scarcely longer than broad; cerci short ..... *lævissimus* Brunner.

b^2. Second and third segments of the abdomen twice as long as broad; cerci long, lanceolate ..... *texanus* Brunner.

a^2. Abdomen multicarinate ..... *striatus* Burmeister.

Pseudoseymyle Caudell has had one species added since the revision of the Phasmidæ of the United States in 1903 by the writer, *P. tenuis*, having been described from Texas in 1909 by Rehn and Hebard. This species, known from a single male specimen, is closely allied to *P. banksii* Caudell. No better table for the separation of the species of this genus than those in the above-mentioned revision have been made. The table there given for the females is fairly satisfactory, but the males are more difficult, and the character of comparative length given for the separation of this sex of *banksii* and *truncata* is not a good one.

The original description of *Hoplolibethra tuberculata* Caudell states that the hind tibiæ are provided beneath with an apical areolate area. This is an inexcusable mistake, there being no trace of such an area.

The later described *Libethra confusa* of Brunner from Mexico seems structurally allied to *Hoplolibethra tuberculata*, but the measurements given for it does not seem to agree very well.

Parabacillus palmeri Caudell described from Mexico has been taken within our borders, specimens in the U. S. National Museum from Oklahoma and Arizona being referred to that species. The diagnostic character of the long legs prove variable, and so this species is reduced to varietal rank.

In my revision of the Phasmidæ I included the first description of *Timema californica*, carefully crediting it to Scudder and quoting his

Digitized by Google

description exactly as sent to me by him and putting it in smaller type, thus properly establishing the species as his creation. Systematists who believe genera without valid species included are properly established will hold that the genus as well as the species should be credited to Scudder. Such, indeed, was my desire and intention, but, according to rules of nomenclature believed in and followed by me, a genus has to be credited to the person first using it in connection with a valid specific name.[1] Thus I am compelled to consider myself as the author of *Timema*.

[1] See paragraph No. 27 of The Entomological Code.

Digitized by Google

DESCRIPTIONS OF NEW SPECIES OF CRABS OF THE FAMILY OCYPODIDÆ.

By MARY J. RATHBUN,

Assistant Curator, Division of Marine Invertebrates, United States National Museum.

While studying Philippine and other Indo-Pacific crabs of the family Ocypodidæ in the United States National Museum, four new species were found which are not included in the material destined for special faunal reports. Three of these are fiddler crabs of the genus *Uca* (=*Gelasimus*) and the fourth is a *Macrophthalmus*.

UCA ZAMBOANGANA, new species.

Plate 74.

Type-locality.—Philippine Islands: Zamboanga, Mindanao; May, 1904; Dr. E. A. Mearns, United States Army; 6 males.

Type.—Cat. No. 43307, U.S.N.M.

Dimensions.—Type male, length of carapace 17.6 mm.; width 29.8 mm.; largest male, length of carapace 23.4 mm., width 39.5 mm.

A large species, belonging to that section of the group of narrow-fronted species in which the lower margin of the orbit has an accessory row of granules above it.

Carapace one and two-third times as broad as long; the orbital margin nearly transverse, the convex portion inclined very slightly backward, separated by a deep sinus from the outer angle, which is acute and points obliquely forward; side margins raised and very sinuous, the anterior part nearly straight, posterior curving strongly inward; dorsal surface deeply sulcate; frontal furrow narrow-triangular, sides concave, tip blunt-pointed; accessory row of granules above the lower margin of the orbit occupying nearly the whole length of the orbit, but not reaching to the inner end and rarely to the outer end, composed of from 20 to 22 fine granules and lying close to the margin.

The large cheliped, which in four out of six males lies on the right side, and in two males on the left side, is very broad and strong; inner margin of arm granulate, not prominent; granules of wrist and palm

Digitized by Google

of median size; upper and lower margins of palm marked off by an impressed line; oblique line of inner surface not very prominent, with one row of tubercles; the convexity of the lower margin of the propodus is interrupted by a very shallow sinus behind the thumb; fingers broad and flat, intervening space narrower than either finger; a very shallow groove through the middle of each finger and a deep groove on the proximal half of the dactylus near the upper edge; prehensile edges each with two teeth, one near the tip and one near the middle, that on the dactylus proximal to that on the immovable finger.

The largest specimen has a proportionately large claw, but with a shorter palm, and the movable finger is devoid of a tooth at the middle; median groove obsolete; immovable finger broken off at the base. This form apparently corresponds to that which is known in various other species of fiddlers where the claw may have a very short palm and simpler fingers as compared to the normal form in that species.

Ambulatory legs with the merus joints expanded, the upper surface with few granules, upper edge distinctly serrated.

This species may be distinguished by its almost transverse anterior margin, the very long accessory row of granules above the lower margin of the orbit, and by the triangular-oblong frontal furrow.

UCA MEARNSI, new species.

Plate 75, figs. 1 and 2.

Type-locality.—Philippine Islands: Davao, Mindanao; Dr. E. A. Mearns, United States Army; 1 female.

An additional female was taken at Negros Island by Dr. Bashford Dean.

Type.—Cat. No. 43383, U.S.N.M.

Dimensions.—Type female, length of carapace 14.2 mm., width 21.2 mm.

This species is represented only by females.

Carapace one and one-half times as broad as long, very convex or almost semicylindrical; surface coarsely granulate, although the granules are scarcely visible to the unaided eye; the branchio-cardiac is the deepest of the dorsal furrows; supraorbital margins nearly transverse, very sinuous; the acutely angled anterior tooth is directed obliquely forward; lateral margins granulate and obtusely angled a little behind the anterior angle; frontal furrow narrow-oblong, tip arcuate; an accessory row of granules above the lower margin of the orbit, occupying less than one-third the length of the orbit and composed of seven or eight granules; the row begins at the outer end close to the margin, but inwardly diverges from it, being in front view transverse or parallel to the eyestalk when folded in the orbit.

Digitized by Google

Ambulatory legs rougher than usual, the merus joints very wide (that of last pair twice as long as wide), their margins strongly serrulate, granules of dorsal surface coarse, scabrous, and rather numerous.

This species in shape approaches *U. zamboangana*, but is much narrower, even considering the difference in the sexes; frontal furrow with parallel instead of converging sides; the accessory row of granules on the lower orbit much shorter and not following the line of the orbital margin.

It also resembles *U. arcuata* (de Haan), but that species has very sinuous side margins and no accessory granules on the lower orbit.

UCA NOVÆGUINEÆ, new species.

Plate 76.

Type-locality.—New Guinea; 2 males, one left-handed, one right-handed; received from the Linnean Society, Sydney, New South Wales.

Type.—Cat. No. 6374, U.S.N.M.

Dimensions.—Male, length of carapace 9.3 mm., width 16 mm.

Allied to *U. gaimardi* (Milne Edwards),[1] from which it differs in the following particulars: Sides of the carapace more strongly convergent, so that the lateral angles are narrower, and project more sideways; the front is correspondingly narrower, being less than one-fifth of the width of the carapace.

While the large cheliped of the male is of the same general pattern as in *U. gaimardi*, the palm lacks the deep triangular depression at the base of the index, so characteristic of that species; the granulation is finer; the furrow just below the superior marginal line of granules is not deeply impressed; the oblique ridge on the inner surface is more prominent and marked with a single row of about eight large granules and several smaller ones; as in *gaimardi* the slender fingers are devoid of a groove on the outer surface, and the index has a tooth at its middle and a smaller one near the tip; the dactylus, instead of two enlarged denticles dividing it into three subequal spaces, has three denticles, one of which is not far from the tip, and the space proximal to which is divided into three subequal spaces.

In the shape of the carapace this species approaches *U. triangularis* (Milne Edwards), but that species has the sides still more convergent, the anterior border of the front more truncate, the movable finger longitudinally grooved.

A young left-handed male from Zamboanga, Mindanao, Philippine Islands, Dr. E. A. Mearns, collector, December, 1903, probably belongs to this species. Carapace 5.8 by 9.6 mm. Front about one-fifth width of carapace, its lower edge a little straighter than in the typical specimens; inner and lower margins of arm of large cheliped

[1] *Gelasimus Gaimardi* Milne Edwards, Ann. Sci. Nat., Zool. (3), vol. 18, 1852, p. 150 [114], pl. 4, fig. 17.

Digitized by Google

more coarsely and sharply granulate; the distal of the two vertical rows of granules inside the palm is composed of very fine granules; the three denticles on the movable finger are all more proximally placed, and the intermediate one has a much smaller space on its proximal than on its distal side.

While it is possible that this specimen represents a new species, it is too undeveloped to be described as such.

MACROPHTHALMUS CRINITUS, new species.

Plate 75, fig. 3.

Macrophthalmus, sp., DE MAN, Abh. Senckenb. naturf. Ges., vol. 25, 1902, p. 495.
Macrophthalmus pacificus RATHBUN, Bull. Mus. Comp. Zoöl., vol. 52, 1910, p. 307, pl. 1, fig. 3. Not *M. pacificus* Dana (1851), de Man (1890)

Type-locality.—Moluccas: Amboyna; Thomas Barbour; 1 male type, 1 female, 1 young (M.C.Z.); 1 male, 1 female (U.S.N.M.).

Type.—Cat. No. 7259, M.C.Z.

Paratypes.—Cat. No. 39493, U.S.N.M.

Dimensions.—Type male, length of carapace 11.2 mm., width 15.3 mm., width of front below 2.5 mm.

Carapace convex, smooth and punctate in the highest portions, irregularly granulate elsewhere; a short oblique granulate line above the last leg; details of surface obscured by coarse hairs. Carapace widening from the anterior angles to the posterior part of the second tooth; behind this point the sides are nearly parallel, but somewhat sinuous; upper margin of orbit very sinuous, directed forward at the antero-lateral tooth; first sinus of the lateral margin triangular; second tooth forming nearly a right angle; third tooth minute. Front slightly constricted, lower edge faintly bilobed. Orbit finely crenulate above, coarsely denticulate below; eyes not reaching end of orbits.

Suture between ischium and merus of outer maxillipeds slightly oblique; outer margin of ischium longitudinal. Chelipeds of male with the merus-joint densely clothed with coarse hair on the lower surface and on the infero-distal part of the inner surface; long fine hairs on the upper, inner, and distal margins; wrist and palm evenly granulate on outer surface, a faint ridge near lower margin of distal end of palm continued more distinctly on immovable finger; upper and lower edges of palm rounded; dactylus with a large truncate tooth behind the middle; the coarsest and most prominent denticulation of the immovable finger is near the distal end. Legs long-hairy above and on the margins; distal tooth of merus-joints small, concealed in dorsal view by the hair; merus of third leg a little less than two and one-half times as long as wide.

Variations.—Specimens smaller than the type have a larger smooth (not granulate) space on the carapace; the lower edge of the front

Digitized by Google

is scarcely bilobed; the ridge on the palm is strong and the upper edge marginate, both in undeveloped males as well as in females.

The species differs from *M. pacificus* Dana [1] in its greater hairiness; in the upper margin of the orbit trending forward at its outer end instead of backward; in the carapace being more quadrate in shape and without sharp lines of granules on the branchial region; in the front having a narrow rim of even width throughout, while in *pacificus* the rim widens along the sides from above downward, so that while the front in its entirety is constricted, the depressed or middle portion of it is not constricted but narrows downward; the tooth on the movable finger plays into a cavity in the immovable finger, while in *pacificus* it moves against or toward an elevation on the immovable finger.

De Man in 1902 [2] contrasts a female without locality label, which he described in 1890,[3] with a female from Tobelo, Halmahera, and thinks that the former may not be *M. pacificus*, as he thought in 1890, because Dana's figure does not show the granular lines on the carapace. De Man further thinks that the Halmahera specimen may be *pacificus* and the 1890 specimen *bicarinatus* Heller.

The 1890 specimen is the same species, I think, as the specimens called *pacificus* in the present paper, while the Halmahera specimen (*Macrophthalmus*, sp., de Man) is the one described here as *crinitus*. The reasons why I attach the name *pacificus* to the former instead of the latter are (1) the shape of the carapace; (2) the depressed portion of the front narrows forward, as it appears to in Dana's figure; (3) the shape and hairiness of the legs correspond; (4) the spine on the meropodites is sharp and plainly visible, which it is not in *crinitus*.

Dana describes the carapace of *pacificus* as "naked and smooth" and figures no granular lines, but the postero-lateral regions are represented as pubescent in the illustration. His type was an immature male of small size; perhaps the lines were inconspicuous.

Heller's figure of *M. bicarinatus* [4] is too unlike the species under consideration to be united with either.

[1] U. S. Expl. Exp., vol. 13, Crust., pt. 1, 1852, p. 314; atlas, 1855, pl. 19, fig. 4 *a–c*.
[2] Abh. Senckenb. naturf. Ges., vol. 25, pp. 495–499.
[3] Notes Leyden Mus., vol. 12, p. 79.
[4] Reise *Novara*, Crust., 1865, pl. 4, fig. 2.

Digitized by Google

EXPLANATION OF PLATES.

PLATE 74.

Fig. 1. *Uca zamboangana*, front view of male, natural size.
2. *Uca zamboangana*, dorsal view of type male, natural size.
3. *Uca zamboangana*, outer view of large (right) chela of a third male, natural size.
4. *Uca zamboangana*, inner view of large (left) chela of a fourth male, natural size.

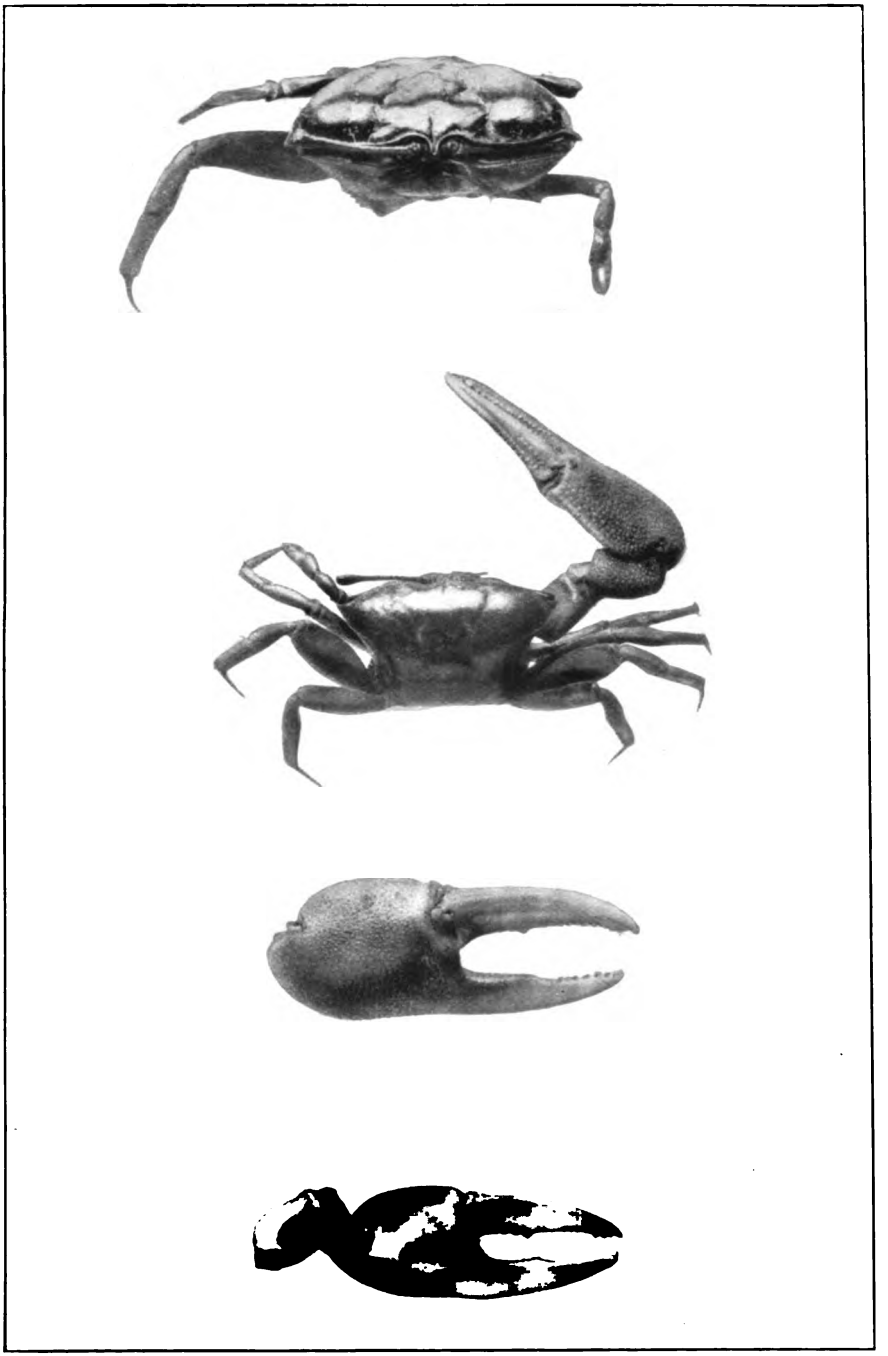
PLATE 75.

Fig. 1. *Uca mearnsi*, front view of type female, ×2.
2. *Uca mearnsi*, dorsal view of type female, ×2.
3. *Macrophthalmus crinitus*, ventral view of type male, ×2.

PLATE 76.

Fig. 1. *Uca novæguineæ*, front view of type male, ×2.
2. *Uca novæguineæ*, dorsal view of type male, ×2.
3. *Uca novæguineæ*, outer view of large chela of same, ×2.
4. *Uca novæguineæ*, inner view of same, ×2.

Digitized by Google

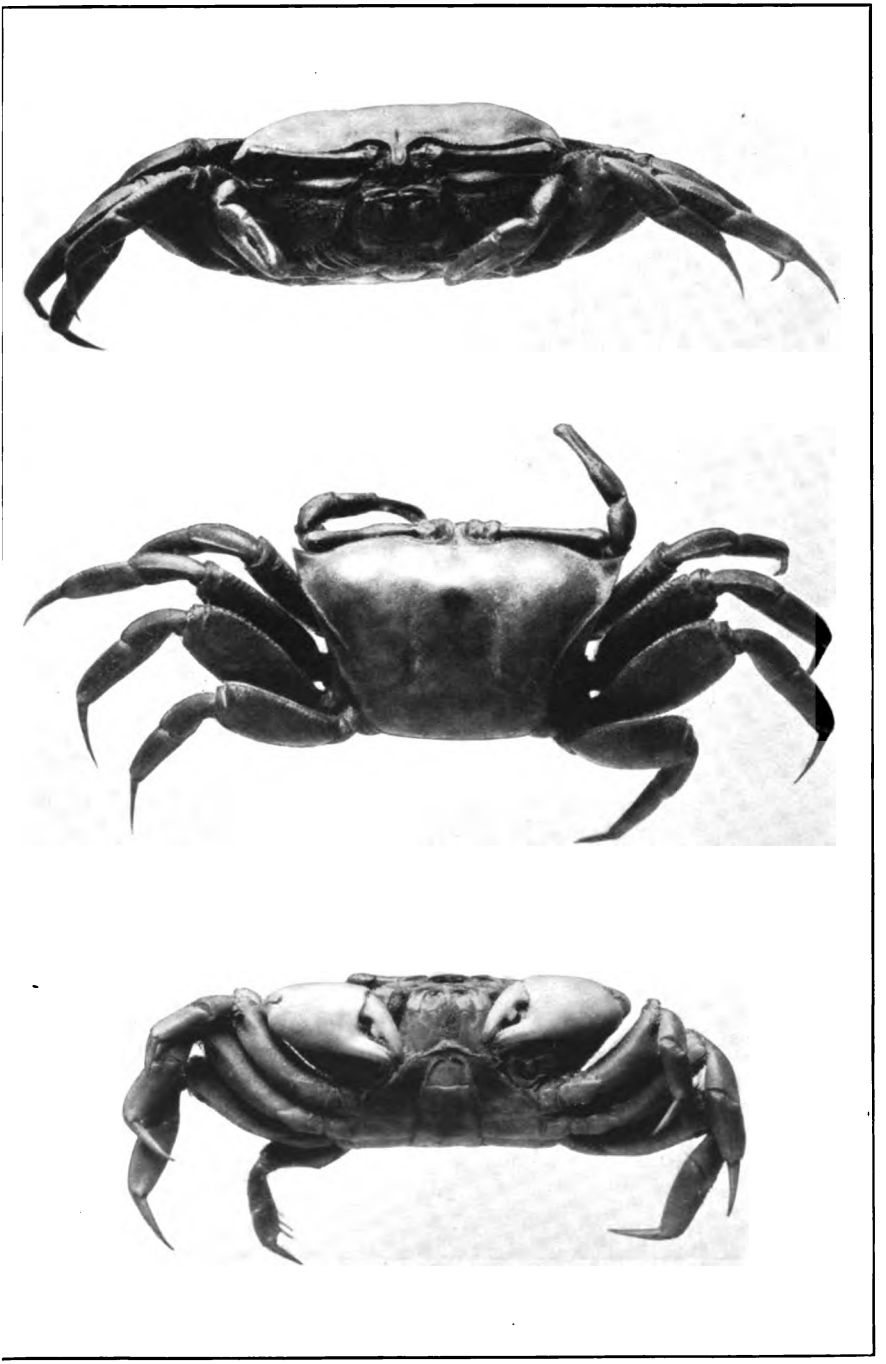


NEW CRABS OF FAMILY OCYPODIDÆ.

FOR DESCRIPTION OF PLATE SEE PAGE 620.

Digitized by Google

Digitized by Google

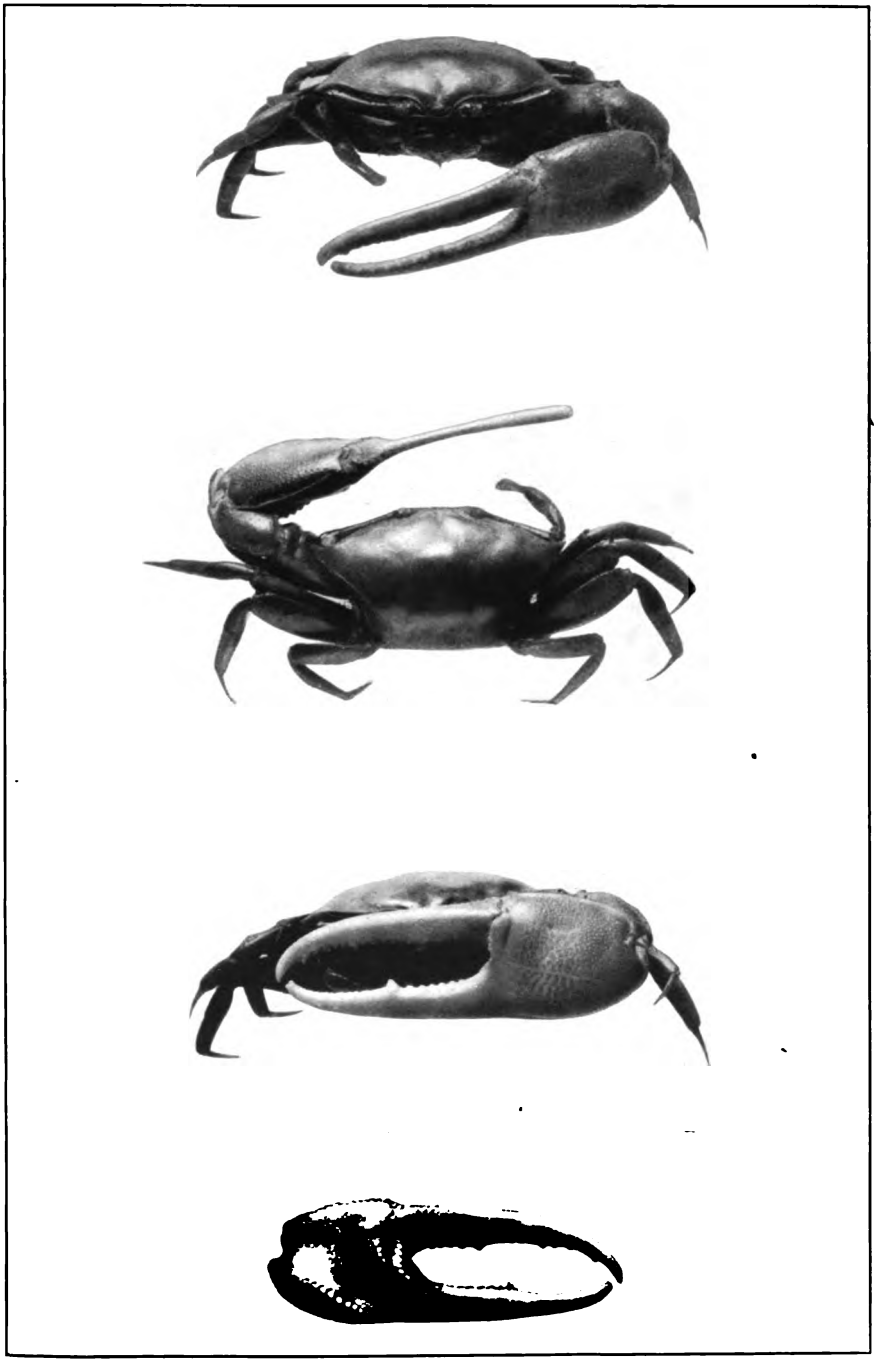


NEW CRABS OF FAMILY OCYPODIDÆ.

FOR DESCRIPTION OF PLATE SEE PAGE 620.

Digitized by Google

Digitized by Google



NEW CRABS OF FAMILY OCYPODIDÆ.

FOR DESCRIPTION OF PLATE SEE PAGE 620.

Digitized by Google

Digitized by Google

NOTES ON SOME AMERICAN DIPTERA OF THE GENUS FANNIA, WITH DESCRIPTIONS OF NEW SPECIES.

By J. R. Malloch,

Of the Bureau of Entomology, United States Department of Agriculture.

INTRODUCTION.

The species of this genus have not so far been treated collectively in any paper dealing with the American species, and the only attempt to describe any of our forms that has been made is that by Herr P. Stein[1] in his paper on North American Anthomyidæ. The only other species described originally from North America are *femorata* Loew, 2 species by Bigot[2] which probably have been recognized by Stein[3] as synonyms of other species (*mexicana* Bigot is a synonym of *F. canicularis* Fabricus), and 3 species described in the larval stage by Fitch,[4] which can not be identified either. The species described by D. W. Coquillett as *Homalomyia flavivaria*,[5] from Alaska, is mentioned in the present paper. It is impossible in the time at my disposal, and with the limited material available, to monograph the genus, but I have given a table of the species in the group which have the abdomen marked with three rows of spots. This characteristic is confined to one European species and those given in this paper from North America and Panama. In one or two cases South American forms possess this coloration in a certain degree, but they need not be considered here.

The principal characters for the separation of this genus from other Anthomyidæ lie, in the male, in the very large eyes, which are almost confluent above and reach to almost the lower margin of sides of head, leaving a very small, almost linear, cheek area; the frons and epistome, in profile, do not project much beyond eyes, the arista is bare, or very slightly pubescent, and the palpi and proboscis are normal. In the female the eyes are separated by about one-third the width of the head, and the cruciate frontal bristles are absent. The abdomen in the male is flat, elongate oval in outline, and the hypopygium is very inconspicuous, except in *glaucescens*

[1] Berl. Ent. Zeit., vol. 42, 1897.
[2] Ann. Soc. Ent. France, No. 33, 1885.
[3] Zeit. Hym. Dipt., vol 7, 1907, p. 273.
[4] Amer. Ent., vol. 2, p. 137.
[5] Proc. Wash. Acad. Sci., vol. 2, 1900, p. 446.

Digitized by Google

Zetterstedt. The wings have the sixth vein very short and the seventh bent up sharply round end of sixth. Several species have the under calyptra unprojecting, and would not readily lend themselves to arrangement according to the key given for the genera of Anthomyidæ in Williston's Manual; but the venation, coupled with the Syrphus-like abdomen of the males, should indicate their generic position readily enough. The other species included in this paper, besides those given in table at beginning, are new to science or to the American list. The notes given with each indicate to what species they are most closely allied, and may probably lead to their identification in many other collections in this country. The drawings given of the legs are not drawn to the same scale, but are true representations individually of the relative lengths and position of the bristles.

Of the 24 species of *Fannia* already described recognizably, or recorded, from the area covered by the species in the present paper, 13 are European, and to these must be added the 5 herewith recorded, making a total of 18 European species, which is a rather large percentage for a Dipterous family.

KEY TO SPECIES FANNIA, WITH TRIPUNCTATE ABDOMEN.

1. Hind tibia with long, soft, hairlike bristles on ventral surfaces.....*pusio*, p. 623.
   Hind tibia without long, hairlike, ventral bristles; at most a few short bristles present..... 2.
2. Dorsum of thorax gray, or yellowish pollinose, with distinct longitudinal stripes.. 3.
   Dorsum of thorax shining black, sometimes slightly pollinose, but never distinctly striped..... 4.
3. Large species 5 mm. Hind femora tuberculate near apex on ventral surface, tuberculate portion with a fasciculus of long curved bristles.....*grandis*, p. 623.
   Smaller species 2½–3 mm. Hind femora not tuberculate and without fasciculus.
   vittata, p. 623.
4. Hind femora with a series of 8–9 straight, fine, close-placed, hairlike bristles on middle third of anteroventral surface; hind tibia with only one anteroventral bristle at near middle.....*trimaculata*, p. 623.
   Hind femora without a series of hairlike bristles at middle, the whole of anteroventral surface with more widely placed bristles which are not of a regular length..... 5.
5. Hind femora with a series of 3 long, hairlike, anteroventral bristles, the middle one duplicated, the first at about middle, the last at two-fifths from apex, and a rather shorter but much stronger bristle midway between the last and the tip of femur.....*conspicua*, p. 624.
   Hind femora otherwise bristled..... 6.
6. Legs mostly yellow; hind femora with 1–2 strong bristles at near apex on anteroventral surface, and a group of long, hairlike bristles on a slightly raised portion, at apical third, on posteroventral surface; hind tibæ with 2 anteroventral bristled.....*benjamini*, p. 625.
   Legs almost entirely black; hind femora without any distinct raised portion, or group of hairs at apical third..... 7.
7. Hind tibiæ with 1 anteroventral bristle..... 8.
   Hind tibiæ with 3–4 anteroventral bristles.....*leucosticta*, p. 627.
8. Hind femur with 6–7 strong anteroventral bristles on apical third..*femoralis*, p. 627.
   Hind femur without those bristles.....*howardi*, p. 626.

Digitized by Google

DESCRIPTION OF SPECIES.

FANNIA PUSIO (Wiedemann).

Fig. 3.

Anthomyia pusio WIEDEMANN, Aussereurp. Zwiefl. Ins., vol. 2, 1830, p. 437.
Homalomyia femorata LOEW, Wien. Ent. Monatsch., vol. 5, 1870, p. 42.

This species is easily separable from any of the others in this group by the long-haired hind tibiæ. The hind femur has the apical third slightly swollen, the dilated portion with a series of 6–7 long hairlike, curled bristles on the anteroventral surface and several shorter, finer hairs on the posteroventral surface. Size 2½–3½ mm. Originally described from South America and redescribed by Loew, from Cuba, as *femorata*. Represented in U. S. National Museum collection by specimens from Florida, no locality (collection Coquillett); Miami, Florida (C. H. T. Townsend); Brownsville, Texas (McMillan and Marshall); a series of 13 specimens bred from cages containing larvæ and pupæ of *Galerucella luteola* Müller (the elm leaf beetle), with note that the larvæ of this and another Anthomyid had destroyed all the pupæ; Guadeloupe, West Indies (Busck); and Trinidad, West Indies (Busck). Though the larvæ of *G. luteola* above referred to were obtained from various States—Connecticut, New York, New Jersey, and New Hampshire—it is not improbable that the Anthomyids obtained access to the cages in Washington.

FANNIA GRANDIS Malloch.

Fig. 1.

Fannia grandis MALLOCH, Smiths. Misc. Coll., vol. 59, No. 17, July, 1912, p. 3.

This species is distinguishable by its size and coloration, as well as the fasciculate hind femur, from any other species of the group except one or two from Bolivia in South America. It was originally described from Panama, and I have not seen it from any other locality.

FANNIA VITTATA Malloch.

Fannia vittata MALLOCH, Smith. Misc. Coll., vol. 59, No. 17, 1912, p. 1.

Unlike any other described species in coloration and armature of legs. Described from Panama and not recognized so far from any other locality.

FANNIA TRIMACULATA (Stein).

Fig. 8.

Homalomyia trimaculata STEIN, Berl. Ent. Zeit., vol. 42, 1897, p. 176.

This species is separable from *femoralis* Stein, to which it is most closely related, by the bristling of the hind femora. Both these species have a number of long, curled, hair-like bristles on the postero-

Digitized by Google

ventral surface near the apex on hind femora, but the regular comb-like series of hair-like bristles is absent from the middle portion in *femoralis*, the whole antero-ventral surface being occupied by a row of wider spaced, more irregular bristles, and at apex armed much as in *pusio*, with 6–7 long bristles. In *trimaculata* the antero-ventral surface of femur is bare except for the series on the middle and one much stronger bristle at near the apex.

Originally described from Jamaica. Represented in collection by specimens from Jamaica (collection Coquillett); Kingston, Jamaica (M. Grabham); Santo Domingo, West Indies (Busck).

FANNIA CONSPICUA, new species.

Fig. 2.

Male.—Brownish black. Frontal orbits silvered, central stripe velvety black. Antennæ with basal two joints and base of third yellow; arista yellow at base. Facial orbits silvered, face white dusted, margin of mouth yellow. Palpi yellow. Thorax slightly shining, disk of mesonotum, and pleuræ gray dusted. Abdomen gray-brown; basal two segments, except central spot and lateral posterior margins, and anterior half of third segment translucent yellow; all segments slightly whitish dusted; viewed from behind the first three segments have a central and lateral black spot each, the apical segments are much suffused with black. Legs yellow; coxæ, femora, and tarsi browned, the latter most distinctly. Wings clear, veins yellowish brown. Calyptræ white. Halteres yellow.

Frontal stripe linear, the central stripe almost obliterated. Antennæ short of mouth margin, arista bare. Palpi of normal size. Acrostical bristles three-rowed from the second pair backwards. Hypopygium normal. Fore tibia with one preapical bristle. Mid femora; antero-ventral surface with 5–6 weak, short, hair-like, irregularly spaced bristles to near middle, 4 longer and stronger bristles beyond them to three-sevenths from apex, and a series, 14–15, of short comb-like bristles beyond them, those on the constricted portion being very close-placed; postero-ventral surface with a regular row of hair-like bristles on the basal two-thirds, those on the apical third longer and much stronger. Mid tibia slightly dilated on apical half; the normal bristles present; pubescence on ventral surface sparse and very short, only longer on beyond middle. Hind femur swollen, but not tuberculate; a series of three hairs on antero-ventral surface, the first just at middle and the last as about two-fifths from apex, a stronger, but shorter bristle midway from last of the series to tip, the middle bristle of series is duplicated by a slightly weaker, hair-like bristle on nearer ventral surface, otherwise the antero-ventral surface is almost bare; postero-ventral surface with three long hairs at about

Digitized by Google

apical third which, are apparently the culmination of a series of very short hairs which runs along the posterior surface and descends at just before this part; hind tibia with 2 dorsal, 1 antero-dorsal, and 2 antero-ventral bristles. Last portion of fourth vein almost three times as long as penultimate; outer cross vein curved and very slightly longer than penultimate section of fourth vein. Lower scale of calyptræ much larger than upper. Length 4 mm.

Type.—Cat. No. 15424, U.S.N.M.

Locality.—Williams, Arizona (H. S. Barber), one male.

FANNIA BENJAMINI, new species.

Fig. 9.

Male.—Black-brown. Frontal orbits silvered, the central stripe velvety black. Antennæ brown, the two basal joints yellow; arista brown. Face grayish-white dusted, upper mouth margin yellowish. Palpi yellow. Disk of mesonotum shining brown, unstriped, lateral and posterior margins gray dusted; pleuræ black-brown, whitish dusted, sutures yellowish. Abdomen black-brown, subshining; all segments with a central black stripe, which is interrupted at the posterior margins of segments, and a rounded spot of same color on each side of all segments; entire abdomen, except on black spots, covered with whitish dusting; numerous bristles on segments; hypopygium inconspicuous. Legs yellow, coxæ and femora browned, the tarsi blackish. Wings clear, veins yellowish. Calyptræ grayish. Halteres yellow.

Frontal stripe linear. Third antennal joint at least half its own length short of reaching mouth margin; arista bare. Acrostical bristles three-rowed from in front, 2 pairs of pre-sutural and 3 pairs of post-sutural dorso-central bristles. Fore tibia with one pre-apical bristle; mid femur, antero-ventral surface with 7–8 bristles on basal half, which are very short and weak at base, but increase in length and strength to middle, and are gradually wider placed, apical half with a comb-like row of bristles, 18–20, the first three of which are of equal length and much stronger than the others, and the remainder gradually reduced in size on the constricted portion at apex of femur; postero-ventral surface with a somewhat similar row of distinctly weaker bristles. Mid tibia with the normal bristling of the group; apical half swollen on ventral surface; the pubescence short. Hind femur with a few short bristles on antero-ventral surface, and two strong bristles at near apex; postero-ventral surface almost bare, slightly swollen at apical third and with a group of 8–9 long, fine, hair-like bristles in a group on the raised part. Hind tibia with 2 dorsal, 1 antero-dorsal, and 2 antero-ventral bristles.

Length 3–3½ mm.

Digitized by Google

Female.—Frons at vertex one-third as wide as head, slightly divergent-sided, the width at above antennæ being about one-fourth more than at vertex; orbits shining, but obscured by whitish dusting; widest at mid way to vertex, and at this part one and one-half times as wide as frontal stripe at same part; middle stripe brownish red with whitish dusting. Palpi slightly spatulate. Mesonotum more thickly dusted than in the male, and with indications of three longitudinal, very fine, brown lines. Abdomen marked as in male, but the spots more diffused. Legs with only the fore femora slightly browned, and the tarsi black; bristling normal; the hind femur with 2 antero-ventral widely placed bristles on apical third, the hind tibia as in male. In other respects as male.

Type and paratypes.—Cat. No. 15425, U.S.N.M.

Type-locality.—Mountains near Claremont, California (C. F. Baker). One male and five females. One male from Santa Clara County, California (C. F. Baker). There are also 3 females from Grand Canyon, Arkansas, taken at a height of about 7,000 feet, marked "very annoying by buzzing round eyes, nose, and mouth" (Schwarz and Barber), and 5 females from Cayamas and Baracoa, Cuba (E. A. Schwarz, and A. Busck).

This species I have named in honor of Dr. Marcus Benjamin, editor of Proceedings of the United States National Museum.

PANNIA HOWARDI, new species.

Male.—Very similar to *trimaculata* Stein, but differing in the bristling of the hind femur. In *trimaculata* there is a short row of close-placed bristles on the middle third, as shown in fig. 7, in *howardi* the same surface, antero-ventral, has an irregular row of much wider placed bristles which extends from base to tip third, the strong bristle present near tip in *trimaculata* being also present in *howardi*. On the postero-ventral surface the row of hairs in *howardi* begins at the base and culminates in 4–5 long curled hairlike bristles at the tip fourth, in *trimaculata* this same row begins at middle with very short hairs and finishes as in *howardi*, but the bristles are closer placed. In other respects the species are very similar, though in some cases there is an additional bristle present on the postero-dorsal surface of mid tibia in *trimaculata*, *howardi* having only the normal one.

Type.—Cat. No. 15444, U.S.N.M.

Locality.—Washington, District of Columbia (collection Coquillett).

One male, Holly Spring, Mississippi (F. W. Mally); and a series bred from cages containing larvæ and pupæ of the Elmleaf Beetle at the same time as the series of *pusio* was obtained.

Named in honor of Dr. L. O. Howard, Chief of the Bureau of Entomology.

Digitized by Google

FANNIA FEMORALIS (Stein).

Homalomyia femoralis STEIN, Berlin. Ent. Zeitsch., vol. 42, 1897, p. 282.

It is unfortunate that Stein chose this name for this species as it is calculated to cause confusion with *femorata* Loew., which is a synonym of *pusio* Wiedemann. This species is most closely allied to *trimaculata* Stein, from which it may be separated by the characters mentioned under the note on that species.

There is only one specimen of this species in collection, which is in rather poor condition, from Winslow, Arizona (E. S. G. Titus).

FANNIA LEUCOSTICTA (Meigen).

Anthomyia leucosticta MEIGEN, Syst. Beschr., vol. 7, 1826, p. 328, species 31, male.
Homalomyia brevis STEIN, Berlin. Ent. Zeitsch., vol. 40, 1895, p. 51.

I have never met with this species, which according to Stein has much the habitus of an *Azelia*. The characters given in the table should serve to identify it.

FANNIA SOCIELLA (Zetterstedt).

Fig. 10.

Aricia sociella ZETTERSTEDT, Dipt. Scand., vol. 4, 1845, p. 1564.

There are in the collection here 7 specimens of this species—4 from White Mountains, New Hampshire (Morrison?); 2 from Mount Washington, New Hampshire (Geo. Dimmock); and 1 from Franconia, New Hampshire (Mrs. A. T. Slosson). The male may be separated from any other described species by the absence of the preapical dorsal bristle from the hind tibia, and the possession of a series of three very strong bristles on middle of antero-ventral surface of mid femur, which are conspicuous from the other bristles.

FANNIA POSTICA (Stein).

Fig. 7.

Homalomyia postica STEIN, Berlin. Ent. Zeitsch., vol. 40, 1895, p. 89.

I have before me 2 specimens which agree with a Scotch specimen of this species. The locality is White Mountains, New Hampshire (Morrison). The species comes very close to *serena* Fallen, but besides being smaller, it has a series of (8–9) bristles on apical half of antero-ventral surface on hind femur, which increase in length toward apex. *Serena* has generally 2–3 longer and stronger bristles, but not a regular row as in *postica*.

FANNIA MORRISONI, new species.

Fig. 11.

Male.—Deep black, subopaque. Only the halteres yellow. Wings fuscous, especially on fore margin, veins black-brown.

Frontal orbits silvered, middle stripe from behind appearing velvety black, from above, brown, at the narrowest part at least as wide as

Digitized by Google

orbits; face with brownish dusting; third antennal joint more than twice as long as second; arista bare; palpi normal. Mesonotum unstriped; brown-gray pollinose on margins; acrostical bristles 3-rowed from third anterior pair; 2 pairs of presuturals. Abdomen ovate, viewed from in front opaque black, from behind with the anterior and lateral margins of segments distinctly white pollinose, leaving a black central stripe and posterior triangular dilatations on each segment; all segments with strong hairs; hypopygium inconspicuous, with apical, central depression. Fore legs with normal bristling. Mid femora with a conspicuous, long, ventral, basal, hair-like bristle; antero-ventral surface with a row of about 20–22 bristles which begin at base rather weak and gradually become longer and rather wider spaced to middle, then decrease gradually in size and become closer placed on the slightly narrowed apical third; the postero-ventral row is of similar nature, but the basal 3–4 are distinctly longer than those on the base of antero-ventral surface; posterior surface with a row of long bristles, which are curled and hair-like to beyond the middle and then stronger, especially the last 3–4 on tip third. Mid tibia gradually thickened toward apex from middle, the pubescence distinct though short; bristling normal. Hind femora with weak hairs on antero-ventral surface, only two very strong bristles on apical third, preceded by two weaker bristles, which are much closer placed; dorsal surfaces, apical third, with several strong bristles. Hind tibia as figure 11. Wings with last section of fourth vein two and one-half times as long as penultimate section. Under scale of calyptræ distinctly longer than upper.

Length, 4½ mm.

Type.—Cat. No. 15426, U.S.N.M.

One male, White Mountains, New Hampshire (Morrison).

This species is allied to *carbonella* Stein, but that species has the calyptræ equal in size or very slightly unequal, and the halteres are black. It also comes very close to *atra* Stein, and *nigra* Malloch. From the first named it differs in the bristling of the hind femora, and from the latter in the absence of the additional bristle above the normal one present on mid tibia, as well as in some minor particulars.

Named after H. K. Morrison, who collected the specimen.

FANNIA ÆTHIOPS, new species.

Figs. 4 and 5.

Male.—Black, distinctly shining, but not glossy. Mesonotum unstriped. Abdomen black-brown, with black central stripe, which is very slightly dilated posteriorly. Legs black, the fore knees inconspicuously yellow. Calyptræ brown. Halteres black-brown.

Eyes separated by a narrow stripe, orbits silvered, central stripe velvety black; antennæ elongate, the third joint reaching to less

Digitized by Google

than its apical width from mouth margin; arista bare; face gray dusted. Mesonotum with acrostical bristles 3-rowed from fourth pair, only 1 pair of presutural dorso-centrals. Abdomen elongate, shaped and colored much as in *serena* Fallen; hypopygium of moderate size, with apical depression, symmetrical. Fore legs of normal shape and bristling. Mid femora very noticeably constricted on apical fourth; antero-ventral surface with a row of bristles, the first 6 long and widely spaced, reaching to middle, then there is a row of about 9 much shorter and closer placed bristles, which decrease rapidly in size to beginning of constriction, where they cease, the last 3–4 are duplicated, the constricted portion is entirely bare except for 4–5 very minute bristles at apex; the postero-ventral surface has much longer, wider-spaced bristles, which become shorter, but stronger, from base to constriction, the constricted part bare, and 4–5 bristles rather longer than those on antero-ventral surface at apex; posterior surface with long curled bristles. Mid tibia thickened on apical half, the pubescence on ventral surface distinct on thickened portion; bristling normal; mid metatarsus with a group of short bristles forming a fasciculus at base. Hind femora bare on ventral surfaces except for 1–2 bristles on apical third of antero-ventral surface, and 4–5 on same part of postero-ventral surface. Hind tibiæ with 2 dorsal, 1 antero-dorsal, and 1 antero-ventral bristles. Last section of fourth vein barely more than twice as long as penultimate section, outer cross-vein at about one-half its own length from end of fifth vein. Under scale of calyptræ very slightly larger than upper.

Length 3–4 mm.

Type.—Cat. No. 15427, U.S.N.M.

This species has the fasciculus at base of mid metatarsus so weak that it is easily overlooked. It, however, belongs to the same group as *aerea* Zetterstedt and *armata* Meigen. It is more closely allied to *umbrosa* Stein, but the description of that species gives a series of 10 bristles on the posterior femur instead of the 4–5 which occur in all the specimens before me. There are also some minor differences between this species and the description given by Stein for *umbrosa*, which prevent me identifying this species with his.

Type-locality.—White Mountains, New Hampshire (Morrison?), three males.

Ainsworth, British Columbia, one male (R. P. Currie); Humboldt County, California, one male (H. S. Barber). The last-mentioned two specimens have the halteres yellowish, which is probably due to their being rather immature. A number of specimens which are standing in the collection as *Homalomyia flavibasis* Stein, belong to *æthiops;* the localities are Virgins Bay, Popoff Island, Muirs Inlet, and Sitka, Alaska (Harriman Alaska Expedition, T. Kincaid).

Digitized by Google

FANNIA GENUALIS (Stein).

Fig. 12.

Homalomyia genualis STEIN, Berl. Ent. Zeitschr., vol. 40, 1895, p. 126.

There is a single male of this species in the collection from White Mountains, New Hampshire (Morrison?). It may be known from any other American species by the broadly whitish-yellow knees and bases of tibiæ. The fore tibia has usually a small bristle in addition to the preapical one, the antero-ventral row of bristles on the mid femur is very slightly interrupted at the narrowed part, which is not much constricted, and the hind femur has a row of hairlike bristles from base to apical third on the postero-ventral surface, the antero-ventral row being shorter and stronger and increasing in size from base to apex.

Originally described from Germany and England.

FANNIA KOWARZI (Stein).

Fig. 6.

Homalomyia kowarzi STEIN, Berl. Ent. Zeitschr., vol. 40, 1895, p. 83.

A single male in collection from Franconia, New Hampshire (Mrs. A. T. Slosson). This species belongs to the group with two bristles on the antero- and postero-dorsal surfaces of mid tibia. The hind femur is peculiar, however, in having a fasciculus of hairs at about apical third on the postero-ventral surface, and one bristle at near apex on antero-ventral surface, otherwise the ventral surfaces are bare. Hind tibia with 2 dorsal, 1 antero-dorsal, 2 antero-ventral, and 4–5 hairlike postero-ventral bristles, the latter confined to apical half.

Originally described from England.

FANNIA PRETIOSA (Schiner).

Homalomyia pretiosa SCHINER, Fauna Austr., vol. 1, 1862, p. 654.

I have seen two specimens of this species collected by Mr. C. W. Johnson. One male, summit of Mount Ascutney, Vermont, July 11, 1908, and another from Machias, Maine.

This species is most closely allied to *splendida* Stein, but may be readily separated from that species by the bristling of the hind tibia, which has 1–3 bristles on the antero-ventral surface, instead of the 4–5 longer antero-ventral bristles and numerous shorter hairs, which are situated on the postero-ventral surface. The mid femur in *pretiosa* has the apical third very slightly constricted, and the row of bristles on the antero-ventral surface is uninterrupted on the constricted portion. The scutellum in *pretiosa* is pale at the apex, while in *splendida* it is entirely black.

Digitized by Google

FANNIA ORNATA (Meigen).

Anthomyia ornata MEIGEN, Syst. Beschr., vol. 5, 1826, p. 191.

This species has been recorded by Stein [1] from Alaska (Sitka), a female specimen collected by Mannerheim being in the Berlin Museum.

It is very difficult to separate *splendida* [2] from *ornata*, and it would have been better had Stein compared the former with *ornata* rather than with *pretiosa*, when he described it, as *pretiosa* is very easily distinguished from either of the other two.

I have seen only a single example of both of these species, *splendida* from Ashford, Washington (Dyar and Caudell), and *ornata* with the date June 20, 1894, No. 513, (collection Coquillett), no other data. It may be that this last is an European specimen, but there is no means of deciding.

The only distinguishing characters by means of which *ornata* may be separated from *splendida* lie in the bristling of the hind tibiæ. In *ornata* the hairs are very long and curl downward toward the tip of the tibiæ, while in *splendida* these hairs are comparatively shorter, and straight, as well as being less numerous. The basal joint of the hind tarsus has also, in *ornata*, hairs on the posterior side, which are longer than in other species in the group, whereas in *splendida* this joint has only normal hairing.

HOMALOMYIA FLAVIVARIA Coquillett.

Homalomyia flavivaria COQUILLETT, Proc. Wash. Acad. Sci., vol. 2, 1900, p. 446.

This is a synonym of *Cœlomyia subpellucens* Zetterstedt, which was recorded from Alaska by Osten Sacken in his Catalogue in 1878. Specimens are in the collection from White Mountains, New Hampshire, (Morrison), and I have also seen a specimen in C. W. Johnson's collection from Maine. The type of *flavivaria* and the series of specimens from Alaska are identical in every respect with those from New Hampshire.

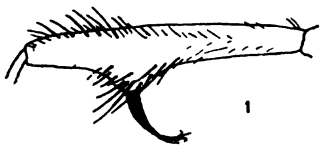
EXPLANATION OF PLATE 77.

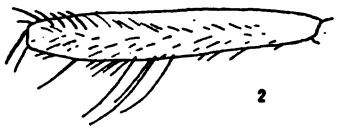
Fig. 1. Hind femur of *Fannia grandis*, anterior side.
2. Hind femur of *Fannia conspicua*, anterior side.
3. Hind femur of *Fannia pusio*, anterior side.
4. Mid metatarsus of *Fannia æthiops*.
5. Hind femur of *Fannia æthiops*, posterior side.
6. Hind femur of *Fannia kowarzi*, posterior side.
7. Hind femur of *Fannia postica*, anterior side.
8. Hind femur of *Fannia trimaculata*, anterior side.
9. Hind femur of *Fannia benjamini*, posterior side.
10. Mid femur of *Fannia sociella*, anterior side.
11. Hind tibia of *Fannia morrisoni*, anterior side.
12. Hind femur of *Fannia genualis*, posterior side.

[1] Ann. Mus. Nat. Hungar., vol. 2, 1904, p. 458.
[2] *Homalomyia splendida* Stein, Berl. entom. Zeitschr., vol. 42, 1897, p. 170.

Digitized by Google

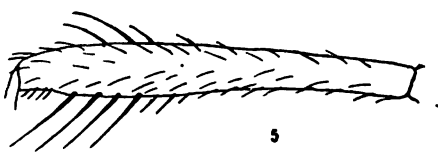
Digitized by Google


1


2

3

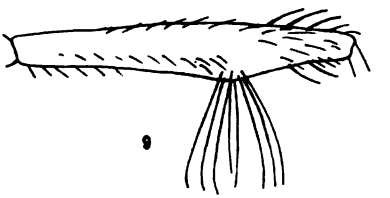
4

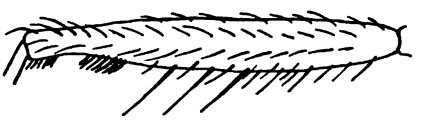

5

6

7

8


9


10

11

12

DETAILS OF LEGS OF SPECIES OF FANNIA.

FOR DESCRIPTION OF PLATE SEE PAGE 631.

Digitized by Google

Digitized by Google

[SCIENTIFIC RESULTS OF THE PHILIPPINE CRUISE OF THE FISHERIES STEAMER "ALBATROSS," 1907–1910.—No. 25.]

NEW TEXTULARIIDÆ AND OTHER ARENACEOUS FORAMINIFERA FROM THE PHILIPPINE ISLANDS AND CONTIGUOUS WATERS.

By JOSEPH A. CUSHMAN,
Of the Boston Society of Natural History.

The species of foraminifera described and figured here belong to the Textulariidæ with the exception of three species of other arenaceous foraminifera belonging to the Astrorhizidæ and Lituolidæ. All are from the dredgings of the United States Fisheries steamer *Albatross* about the Philippine Islands and in contiguous waters, the material from which has kindly been placed in my hands by the Bureau of Fisheries for the description of the Foraminifera. All of the species here described belong to known genera but all are apparently undescribed. Some of these are of very large size for this group.

TEXTULARIA VERTEBRALIS, new species.

Plate 78, fig. 1.

Description.—Test elongate and tapering, chambers very numerous, in the adult portion rounded in cross section, the distal portion of the chambers convex, the proximal portion concave behind the middle, chambers gradually increasing in size, wall composed of agglutinated sand, usually fine, and smoothly finished; aperture at the base of the inner margin of the chamber; color gray.

Length up to 6 mm.

Type-specimen.—Cat. No. 8501, U.S.N.M., from *Albatross* station D5512, off northern Mindanao, 445 fathoms.

This species is a very characteristic one, resembling a series of vertebræ, the chambers in adult specimens very numerous, as many as 60 having been counted in some of the specimens. It is also one of the largest species of the genus.

TEXTULARIA IMMENSA, new species.

Plate 79, fig. 2.

Description.—Test large and broad, rhomboid, very much flattened, chambers low and long; wall thick, of rather coarse angular sand grains imbedded in an unusually large amount of light gray

Digitized by Google

cement; aperture consisting of a series of small openings running from the inner margin of the apertural face to the highest point at the distal end of the test, about 20 in number; color gray.

Length up to 6 mm., breadth up to 4 mm., thickness 0.5 mm.

Type-specimen.—Cat. No. 8502, U.S.N.M., from *Albatross* station D5567, north of Tawi Tawi, 268 fathoms.

This is a very large species and with its peculiar aperture is of more than usual interest. The whole test is rhomboid, very flattened, the two sides seeming to differ, one being slightly convex, the other slightly concave, the concave side having the sutures more prominent than the other.

TEXTULARIA EXCAVATA, new species.

Plate 79, fig. 5.

Description.—Test rhomboid, composed of comparatively few chambers, early portion with the sides angled, later chambers broadly rounded at sides, chambers obliquely set, each forming an angle of 90° with the opposite chamber, distal portion of chamber thickened and tending to roll back, giving an excavated appearance to the test, outer face of last-formed chamber in adult broadly rounded and convex; aperture at the base of the inner margin of the chamber; wall composed of rather fine sand with a grayish-brown color due partly to the cement.

Length up to 2 mm. in adult specimens.

Type-specimen.—Cat. No. 8503, U.S.N.M., from *Albatross* station D5236, Pacific Ocean, east coast of Mindanao, 494 fathoms.

At this station the species was common. Its shape and peculiar sculptured test will distinguish it from other species.

TEXTULARIA SEMIALATA, new species.

Plate 80, figs. 6, 7.

Description.—Test much compressed, of numerous chambers, broader than high, the proximal outer angle of the adult chambers more or less projecting and extending backward, wall of fine sand, very smoothly finished; aperture at the inner margin of the chamber; color gray.

Length about 1 mm.

Type-specimen.—Cat. No. 8504, U.S.N.M., from *Albatross* station D5214, east of Masbate Island, 218 fathoms.

This species in some of its characters resembles *Bolivina beyrichii* Reuss. It is a true *Textularia*, however, and has many points in which it differs from that species. There is a considerable difference in the microspheric and megalospheric forms, both of which are here figured. The microspheric form is narrow at the beginning and

Digitized by Google

continues this form for some time, finally broadening out somewhat. The megalospheric form starts almost at once to develop a broad test of fewer chambers, but each has the same characteristic shape of the chambers.

BOLIVINA SCULPTURATA, new species.

Plate 80, fig. 2.

Description.—Test flattened, rhomboid, chambers nearly flat on the surface, the borders raised with a rounded rim, as are also the areas above the sutures, proximal end rounded, distal end tending to become uniserial; aperture on the terminal face of the last formed chamber, on the inner face of the previously formed ones; wall composed of finely granular material, yellowish-brown, raised borders of a whitish calcareous material.

Length about 1 mm.

Type-specimen.—Cat. No. 8505, U.S.N.M., from *Albatross* station D5236, Pacific Ocean, east coast of Mindanao, 494 fathoms.

The peculiar ornamentation of this species, with its terminal aperture as well as the materials of its construction, make this species a distinctive one.

CLAVULINA ROTUNDATA, new species.

Plate 79, fig. 3.

Description.—Test of comparatively few chambers, tapering, apertural end broadly rounded, early portion triserial and conical followed by two or three chambers biserially arranged and the last formed chambers uniserial; wall thick, composed of fine sand grains with a dark reddish-brown cement; smooth; aperture terminal, large and rounded, depressed without a neck; color reddish-brown.

Length 2.5 - 3 mm.

Type-specimen.—Cat. No. 8506, U.S.N.M., from *Albatross* station D5512, off northern Mindanao, 445 fathoms.

It is not uncommon at this and other stations.

This species is much shorter than most other species of the genus, broadly rounded at the apertural end, the wall thick and resembling that found in *Hormosina* and some species of *Trochammina*, *Ammodiscus*, etc. The aperture, instead of having a neck, shows rather the lack of it, the actual opening into the last formed chamber being in a slight depression.

CLAVULINA PRIMÆVA, new species.

Plate 80, figs. 4, 5.

Description.—Test elongate, cylindrical, slender, composed of numerous chambers; early portion triserial, median portion biserial, terminal portion uniserial; chambers high; wall thick, light gray in

Digitized by Google

color, smooth, sutures slightly depressed; aperture small, with a slight neck, more marked in the young stages.

Length about 3 mm.

Type-specimen.—Cat. No. 8507, U.S.N.M., from *Albatross* station D5585, vicinity of Sibuko Bay, Borneo, 476 fathoms.

This species is peculiar in the retarded taking on of the typical uniserial character of chamber arrangement and in the length of time that the biserial condition is held. In this it is distinctly primitive, much more so than in any other known species. The early triserial condition, on the other hand, is not much longer held than in some other species of the genus. The figure of a young specimen shows the typical clavuline neck even while the biserial condition is still held.

GAUDRYINA ATTENUATA, new species.

Plate 80, fig. 3.

Description.—Test elongate, composed of numerous chambers, early portion triserial, triangular in cross section with sharp angles, biserial chambers numerous, nearly as high as broad, in later development each chamber running nearly or quite to the opposite side of the test; wall rough, composed of rough sand grains and sponge spicules roughly cemented, aperture at first textularian, becoming more nearly circular in the last formed chambers; color light gray.

Length about 3 mm.

Type-specimen.—Cat. No. 8508, U.S.N.M., from *Albatross* station D5259, off northwestern Panay, 312 fathoms.

This species differs from *G. filiformis* Berthelin in its sharply triangular basal portion and in its more loosely biserial form, as well as the form of the aperture. It differs from *G. pseudofiliformis* Cushman in the aperture, the very rough surface and more loosely biserial character. The apertural end tends to become attenuate but not to assume a clavuline character.

GAUDRYINA RCEUSTA, new species.

Plate 78, fig. 2.

Description.—Test large, stout, early portion sharply triangular, triserial, later chambers biserial, rounded; wall made up of fine sand grayish in color, with numerous black specks; surface somewhat rugose, sutures slightly depressed, sides of early portion somewhat concave; aperture textularian, in a rather deep reentrant of the inner border of the chamber.

Length 4 mm., breadth 2 mm.

Type-specimen.—Cat. No. 8509, U.S.N.M., from *Albatross* station D5612, Gulf of Tomini, Celebes, 750 fathoms.

This is a large species, very robustly built, the early portion concavely triangular, the later portion very much rounded. The specimen figured shows but a few of the biserial chambers.

Digitized by Google

VIRGULINA CORNUTA, new species.

Plate 80, fig. 1.

Description.—Test pointed at the initial end, broadly rounded at the apertural end, whole test curved, irregularly biserial, last formed chambers very tumid, aperture a comma-shaped opening with a surrounding raised portion; wall thin and translucent, smooth.

Length about 0.8 mm.

Type-specimen.—Cat. No. 8510, U.S.N.M., from *Albatross* station D5284, China Sea, near southern Luzon, 422 fathoms.

This species is peculiar in its hornlike shape, its very tumid last formed chambers and tapering curved early portion.

THURAMMINA PAPYRACEA, new species.

Plate 79, fig. 4.

Description.—Test spherical, wall extremely thin and delicate, composed of fine sand grains, sponge spicules and a brownish cement; apertures very small and inconspicuous.

Diameter 1.5 mm.

Type-specimen.—Cat. No. 8511, U.S.N.M., from *Albatross* station D5613, north of Celebes, 752 fathoms.

This is a large species with a paper thin wall and very inconspicuous apertures.

REOPHAX AGGLUTINATUS, new species.

Plate 79, fig. 6.

Description.—Test large and stout, composed of several chambers, nearly globular or slightly pyriform; wall composed almost entirely of agglutinated foraminiferal tests of *Globigerina* and *Pulvinulina* held together with a light grayish cement; aperture with a slightly protuberant neck.

Length about 6 mm.

Type-specimen.—Cat. No. 8512, U.S.N.M., from *Albatross* station D5377, vicinity of Marinduque Island, 400 fathoms.

This is a large species and peculiar in its agglutinated test made up almost entirely of other foraminiferal tests. In this respect it resembles *R. bilocularis* Flint but is a typical uniserial *Reophax.*

AMMOCHILOSTOMA ROTUNDATA, new species.

Plate 79, fig. 1.

Description.—Test nearly spherical or somewhat ovate, of few chambers, two only visible from the exterior, the last formed chamber covering all but a small part of the preceding one each time as added, chambers arranged in an irregular coil; wall fairly thick, of

Digitized by Google

fine sand grains with a grayish-brown cement; aperture narrow and elongate in adult chambers, but rounded in the early ones, near the middle of the terminal face of the last formed chamber, but removed from the border of the preceding chamber; color light brown.

Diameter about 1 mm. or over.

Type-specimen.—Cat. No. 8513, U.S.N.M., from *Albatross* station D5613, north of Celebes, 752 fathoms.

Usually in the specimens broken back there are four chambers, sometimes five. The increase in size is very rapid, after the second chamber. In adult specimens the last formed chamber is nearly spherical but the preceding chamber appears as a slight protuberance, often causing an ovate shape. The species was found in considerable numbers at this and other stations.

EXPLANATION OF PLATES.

PLATE 78.

Fig. 1. *Textularia vertebralis*. ×25. *a*, front view; *b*, apertural view.
2. *Gaudryina robusta*. ×18. *a*, view from angle; *b*, apertural view; *c*, view from flattened side.

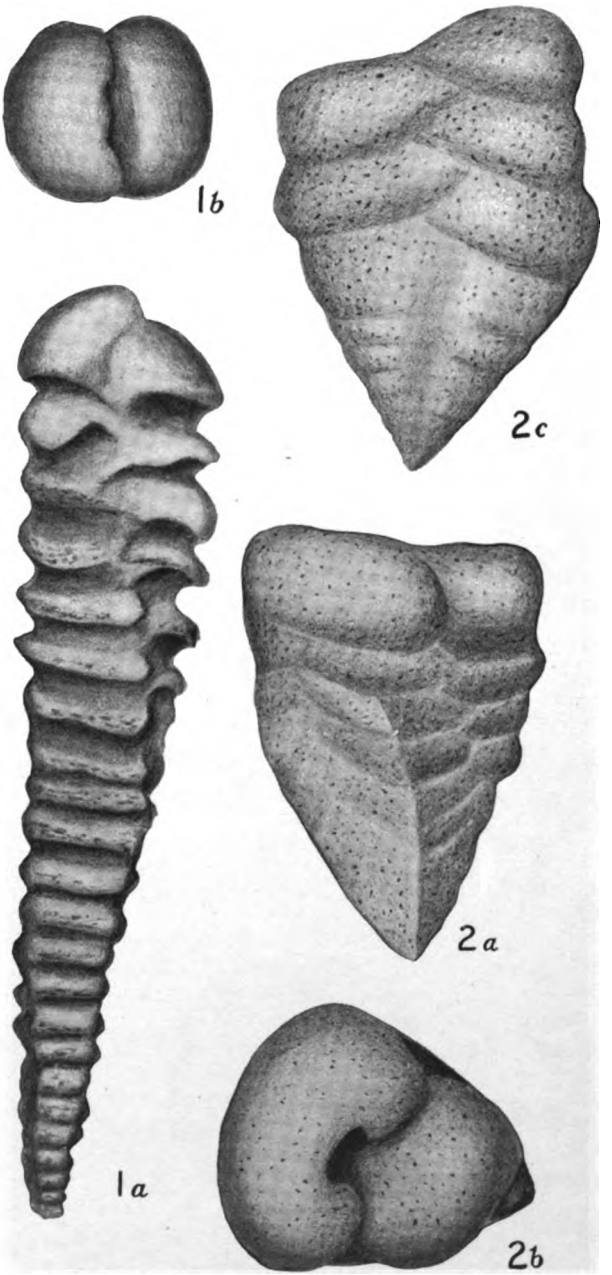
PLATE 79.

Fig. 1. *Ammochilostoma rotundata*. ×33. *a*, apertural view; *b*, front view.
2. *Textularia immensa*. ×10. *a*, apertural view, showing the several apertural openings; *b*, front view.
3. *Clavulina rotundata*. ×25. *a*, apertural view; *b*, front view.
4. *Thurammina papyracea*. ×25.
5. *Textularia excavata*. ×20. *a*, apertural view; *b*, front view.
6. *Reophax agglutinatus*. ×10. *a*, apertural view; *b*, front view.

PLATE 80.

Fig. 1. *Virgulina cornuta*. ×50. *a*, front view; *b*, rear view; *c*, apertural view; *d*, side view.
2. *Bolivina sculpturata*. ×40. *a*, apertural view; *b*, front view.
3. *Gaudryina attenuata*. ×25. *a*, front view; *b*, apertural view; *c*, apertural view of an earlier portion of the uniserial stage with the aperture asymmetrical; *d*, apertural view of the biserial stage.
4. *Clavulina primæva*. ×25. Young specimen showing biserial stage with the aperture at the inner margin of the chamber, but tubular.
5. *Clavulina primæva*. ×25. *a*, apertural view; *b*, front view.
6. *Textularia semialata*. ×50. *a*, apertural view; *b*, front view. Microspheric specimen.
7. *Textularia semialata*. ×50. Megalospheric specimen.

Digitized by Google

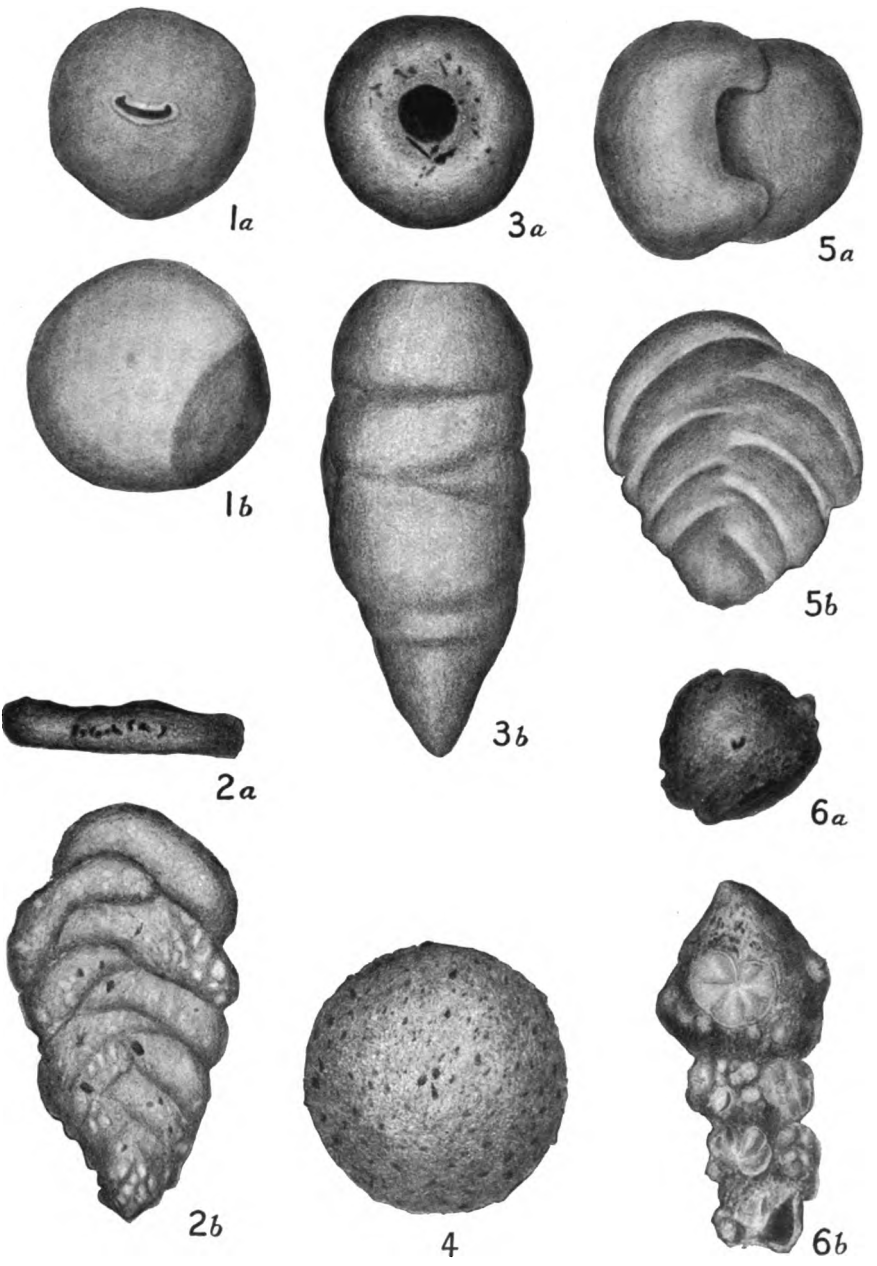


NEW ARENACEOUS FORAMINIFERA FROM THE PHILIPPINES.

FOR EXPLANATION OF PLATE SEE PAGE 638.

Digitized by Google

Digitized by Google

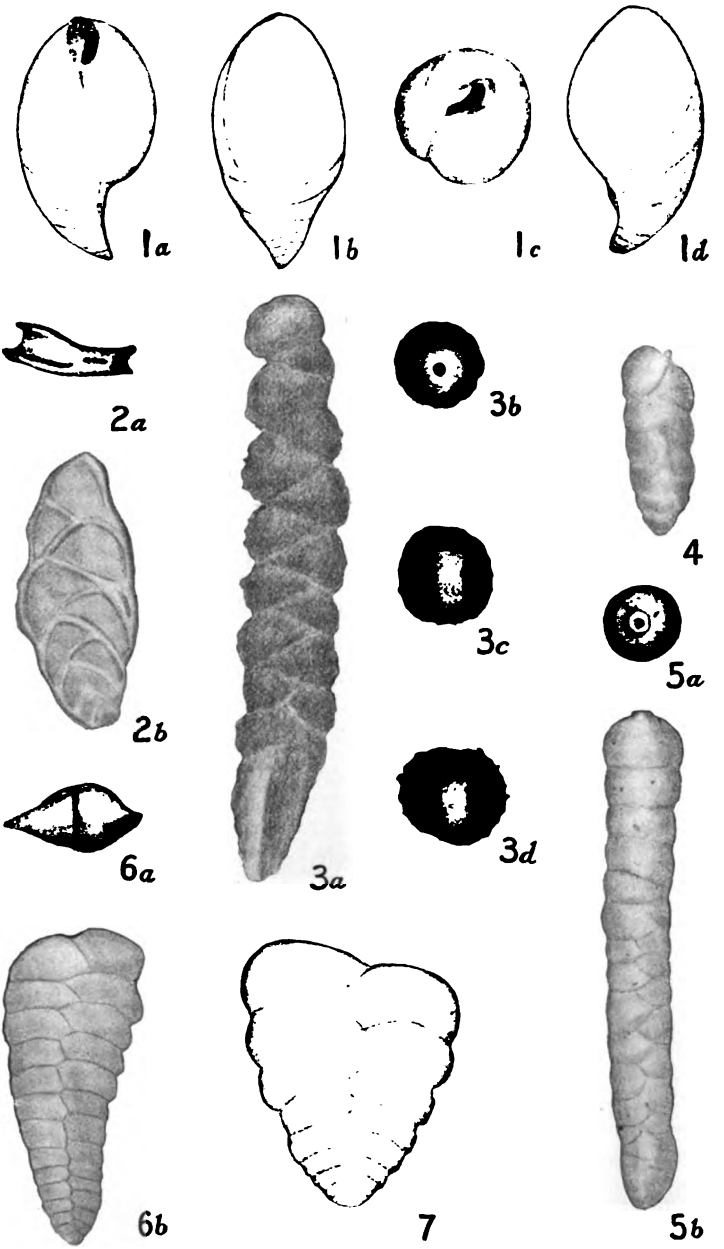


NEW ARENACEOUS FORAMINIFERA FROM THE PHILIPPINES.

FOR EXPLANATION OF PLATE SEE PAGE 638

Digitized by Google

Digitized by Google



NEW ARENACEOUS FORAMINIFERA FROM THE PHILIPPINES.

FOR EXPLANATION OF PLATE SEE PAGE 638.

Digitized by Google

Digitized by Google

DESCRIPTIONS OF SIX NEW GENERA AND TWELVE NEW SPECIES OF ICHNEUMON-FLIES.

By H. L. VIERECK,
Of the Bureau of Entomology, United States Department of Agriculture.

This paper deals chiefly with reared species sent to the Bureau of Entomology, United States Department of Agriculture, for determination.

The families, genera, and species in this paper are arranged alphabetically.

Family ALYSIIDÆ.

ASOBARA ORIENTALIS, new species.

Type-locality.—India.

Type.—Cat. No. 15288, U.S.N.M.

Female.—Length 1.5 mm. Polished; face including clypeus and mandibles stramineous, the teeth of the latter with dark edges, vertex and upper part of occiput brownish, lower part of occiput and cheeks stramineous, ocelli equidistant or nearly so, the lateral ocelli nearly twice as far from the eye margin as from each other, mouth parts pale stramineous, palpi whitish, scape and pedicel stramineous, flagel 25-jointed, brownish, excepting the last seven joints which are whitish; prothorax stramineous as is the dorsulum and the scutel; notauli present only anteriorly, dorsulum with a median punctiform depression near the posterior edge, mesopleuræ blackish, the sternauli present and rather foveolate, mesosternum brownish; wings with a yellowish tinge; veins and stigma pale brown, legs stramineous; propodeum brownish, with a median longitudinal carina from the base to the oblong areola and an apical transverse carina; metapleuræ blackish and separated from the propodeum by a carina; first, dorsal, abdominal segment stramineous, with two parallel longitudinal carinæ, convex and carinate along the lateral margin, rest of abdomen rather blackish except the hypopygium, ovipositor and sheaths which are pale stramineous.

Labeled, "Fruit fly parasite, 1906; George Compere, collector."

Digitized by Google

Family BRACONIDÆ.

AMYOSOMA, new genus.

Type-species.—*Amyosoma chilonis*, new species.

Judging from a comparison with *Myosoma pilosipes* Ashmead this genus differs from *Myosoma* Brullé chiefly in the character of the first three dorsal, abdominal segments, the plate of the first being nearly parallel sided and at least three times as long down the middle as wide at the apex, the plate of the second being distinctly narrower at base than long down the middle and in the third which is without oblique lateral furrows. The false suture between the second and third segments is represented by a smooth and rather deep channel.

AMYOSOMA CHILONIS, new species.

Type-locality.—Taihoku, Formosa.

Type.—Cat. No. 15329, U.S.N.M.

Female.—Length 3.5 mm. Polished, head reddish except the vertex and the occiput above a horizontal line drawn tangent to the upper edge of the occipital foramen; lateral ocelli apparently a little nearer to the anterior ocellus than to each other and approximately twice as far from the nearest eye margin as from each other, antennæ blackish; thorax reddish, excepting the metapleuræ which are blackish or black, fore legs with their coxæ, trochanters, tip of femora, tibiæ and tarsi more or less stramineous or brownish stramineous, remaining legs mostly black or blackish, wings brownish, tegulæ and wing base stramineous, stigma darker than the membrane, veins rather blackish brown; abdomen black or blackish except for the membranous portion of the first and second segments and an apical margin of the third and following dorsal segments, the apical margin interrupted medially on the third, fourth, and fifth segments, broadest laterally, all of which are whitish; exserted portion of ovipositor apparently as long as the first and second abdominal segments combined.

Allotype.—Essentially as in the type except the sixth dorsal abdominal segment, which is entirely black.

Labeled, "Ex *Chilo simplex*, July, 1911, No. 28; T. Shiraki, collector."

A male paratopotype has the head mostly blackish where the type is reddish, the fore legs and mid trochanters stramineous throughout, the propodeum partly reddish, the second, dorsal, abdominal segment brownish stramineous, and the third, fourth, and fifth, dorsal segments partly blackish stramineous.

Digitized by Google

ARICHELONUS, new genus.

Type-species.—*Chelonus aculeatus* Ashmead.

Related to *Chelonus* Panzer, strictly speaking, from which it differs in the nondecurved apex of the abdomen, which recalls the apex of the abdomen in *Omalus* Panzer, barring the emargination, which is not present in this genus.

DIACHASMIMORPHA, new genus.

Type-species.—*Diachasmimorpha comperei*, new species.

Related to *Diachasma* Foerster as represented by *D. crawfordi* Viereck, from which it differs chiefly in the rounded anterior edge of the clypeus and in the presence of sternauli.

DIACHASMIMORPHA COMPEREI, new species.

Type-locality.—India.

Type.—Cat. No. 15330, U.S.N.M.

Female.—Length 4 mm. Brownish stramineous, polished, face punctured, lateral ocelli nearer to the anterior ocellus than to each other and twice or a little more than twice as far from the eye margin as from each other, scape depressed and like the pedicel dark brownish stramineous, flagel blackish and 51-jointed, mandibles with blackish tips; wings with a brownish tinge, stigma and veins dark brown; claws and empodia blackish, as are the hind trochanters, tips of hind femora and most of hind tibiæ and tarsi, the joints of the latter beyond the metatarsi stramineous at base, the onychium mostly stramineous; propodeum rather reticulate and with a median longitudinal carina extending from the base to the areopetiolarea, which latter is parallel sided; first, dorsal, abdominal segment with its longitudinal carinæ parallel and inclosing a longitudinally striate embossed area, which is convex but not gibbose, the first segment apparently a little longer down the middle than wide at apex, second dorsal segment with a large trapezoidal area of striæ the lateral striæ of which diverge posteriorly, third dorsal segment with the basal two-thirds black; hypopygium extending beyond the pygidium; sheaths blackish; ovipositor brownish, with its exserted portion a little longer than the body.

Labeled, "Fruit fly parasite, India, 1906; George Compere, collector."

Named for Mr. George Compere.

HABROBRACON MALI, new species.

Type-locality.—Vienna, Virginia.

Type.—Cat. No. 15331, U.S.N.M.

Female.—Length 3 mm. Related to (*Bracon*) *H. xanthonotus* (Ashmead), from which it differs chiefly as follows: Flagel 25-jointed;

Digitized by Google

posterior half of prescutum black or blackish with the notauli represented by testaceous lines; body mostly black or blackish, second, third, and fourth, dorsal abdominal segments more or less reddish brown.

Allotype.—Flagel 26-jointed; essentially as in the type, but with the reddish brown color of the abdomen replaced by stramineous.

Labeled, "Bred from cocoon under band on apple, Quaintance No. 7862, Aug. 29, 1912; Sept. 1, 1912; J. D. Luckett, collector."

MICROBRACON HISPÆ, new species.

Type-locality.—Taihoku, Formosa.

Type.—Cat. No. 15332, U.S.N.M.

Female.—Length 1.5 mm. Related to *M. rhyssemati* Ashmead, with which it agrees in having the abdomen granular but not leathery throughout above, in the propodeum not being simple, or sculptured all over and in having the dorsum of the head and thorax uniformly stramineous, but differs in the dorsum of the body as well as the rest of the body being uniformly stramineous in the pale stramineous stigma and in the propodeum having simply a median carina but otherwise almost perfectly smooth and polished except for some subtle sculpture near the apex and along the median carina.

Allotype.—Essentially as in the type.

Labeled, "Ex larva, *Hispa callicantha*, Oct., 1911; T. Shiraki, collector; No. 16."

APANTELES (PROTAPANTELES) FORMOSÆ, new species.

Type-locality.—Taihoku, Formosa.

Type.—Cat. No. 15333, U.S.N.M.

Female.—Length 2 mm. Essentially as in *A.* (*Protapanteles*) *stauropi* Viereck, of which it may prove to be a race, the principal difference being in the second, dorsal, abdominal plate being more densely sculptured at base than elsewhere instead of being uniformly sculptured throughout, and in the dorsum of the abdomen being black throughout except the extreme lateral edges which are more or less stramineous.

Labeled, "From larva of Notodontid? Dec., 1911, No. 104; T. Shiraki, collector."

APANTELES (PROTAPANTELES) NARANGÆ, new species.

Type-locality.—Taihoku, Formosa.

Type.—Cat. No. 15334, U.S.N.M.

Female.—Length 1.5 mm. Black; antennæ labrum and mandibles brownish, palpi yellowish; dorsulum and scutel densely, conspicuously punctured, mesopleurse without a carinate fold, tegulæ stramineous, wings transparent, with a brownish tinge, stigma, radius,

Digitized by Google

transverse cubitus, and third abscissa of cubitus brownish stramineous, other veins almost colorless except for a brownish cast, radius and transverse cubitus forming an arc of a circle, legs excepting hind coxæ and all tarsi mostly reddish yellow, tarsi brownish, hind coxæ black, yellowish at apex, hind femora at apex, and hind tibiæ at base and apex more or less dusky; propodeum rugose, indistinctly carinate down the middle; first, dorsal, abdominal plate wider at apex than at base and dullish rugose, distinctly wider at apex than the second plate is long down the middle; second, dorsal plate transversely oblong, rugulose throughout and with a sharp line of demarkation between it in the sculptureless or virtually sculptureless third dorsal abdominal segment, ovipositor hardly exserted, hypopygium not surpassing the pygidium.

Allotopotype.—Essentially as in the type, the pale part of the legs rather stramineous.

Labeled, "From larva of *Naranga diffusa* May, 1911, No. 18; T. Shiraki, collector."

Cocoons yellowish brown, arranged obliquely in rows on blades of grass.

SHIRAKIA, new genus.

Type-species.—*Shirakia schoenobii*, new species.

Related to *Habrobracon* (Ashmead) Johnson in venation but differs radically in the complete crenulated notauli and in the second, dorsal, abdominal segment having an oblique furrow on each side, the furrows converging but not meeting apically.

Named for Dr. T. Shiraki.

SHIRAKIA SCHOENOBII, new species.

Type-locality.—Taihoku, Formosa.

Type.—Cat. No. 15335, U.S.N.M.

Female.—Length 4.5 mm. Head shining, mostly reddish, face with a blackish stain on each side, finely sculptured and indefinitely punctured, front with a large black mark occupying the middle two-fourths and extending from between the insertion of the antennæ upward between and around the ocelli, the latter collectively circumscribed by a furrow that is prolonged below the anterior ocellus and ends in a poorly developed carina between the antennal fossæ, lateral ocelli a little nearer to the anterior ocellus than to each other and nearly three times as far from the nearest eye margin as from each other, occiput brownish stramineous, finely sculptured, and with scattered indefinite punctures; cheeks and malar space stramineous, the former sculptured somewhat like the occiput, the malar space finely sculptured; mandibles with blackish tips, palpi brownish, other mouth parts stramineous, scape stramineous beneath, antennæ else-

Digitized by Google

where mostly blackish, flagel 50-jointed; pronotum stramineous, its sides stramineous along the upper and lower edge, elsewhere blackish, its furrow foveolate; mesosternum black, fore coxæ internally, distal trochanters of fore legs, fore femora posteriorly and also above the longest axis in front, brownish stramineous, otherwise the fore legs are mostly blackish; dorsulum and scutel reddish, hardly sculptured, the prescutum stongly convex anteriorly, the notauli almost meeting before reaching the hind edge of the mesonotum and continued close to the hind edge almost as one longitudinal furrow; tegulæ, wing base, and the true metanotum stramineous; mesopleuræ blackish and sculptured above the middle, blackish red and almost sculptureless below the middle; mesosternum and metapleuræ black, the latter sculptured somewhat like the upper half of the mesopleuræ; wings brownish, stigma and veins blackish brown; mid and hind femora reddish brown, the remaining parts of the mid and hind legs black except a rather stramineous annulus near the base of the tibiæ, claws with a stout tooth at base, empodia surpassing the tips of the claws, hind onychii as long as the two preceding joints combined; first, dorsal, abdominal segment rugose except on the vertical anterior face which is smooth, blackish, apparently twice or more than twice as wide at apex as long down the middle, the dorsal face convex and flanked by depressed, broad, lateral margins, second to fifth, dorsal segments inclusive mostly rugose and with smooth, lateral lunulæ, one on each side; second, dorsal segment with its furrows stramineous as is the posterior edge between the furrows, the area defined by the furrows, blackish stramineous, the sides beyond the furrows blackish, lunulæ stramineous, the apex of this segment arcuate and more than twice but less than three times as wide at apex as the segment is long down the middle; false suture stramineous and crenulate; third to sixth dorsal segments with a stramineous, rugulose band down the middle, this band broadest at base and becoming attenuate apically; third, fourth, and fifth dorsal segments with lateral margins brownish stramineous, the apical edge of the third and fourth and apical third of fifth segments brownish stramineous to pale stramineous, elsewhere the third to fifth segments, inclusive, are blackish; sixth dorsal segment concealing the seventh, convex, almost semicircular in outline, mostly rather dark stramineous; pygidium in color and outline nearly like the sixth dorsal segment; hypopygium acute, its tip falling far short of the apex of the abdomen; exserted portion of the ovipositor apparently half as long as the abdomen.

Allotype.—Compared with the female, this differs chiefly as follows: Basal joints of palpi stramineous; flagel 53-jointed, antennæ colored as in the female; legs stramineous excepting the tibiæ and tarsi, which are rather brownish to dark brown; sixth dorsal segment almost entirely concealing the tip of the abdomen; otherwise essen-

Digitized by Google

tially as in the type except that the parts not mentioned as differing in color are uniformly or nearly uniformly stramineous.

Labeled, "Ex larvæ, *Schoenobius bipunctifera*, Dec., 1911, No. 29; T. Shiraki, collector."

APANTELES (STENOPLEURA) NONAGRIÆ, new species.

Type-locality.—Taihoku, Formosa.

Type.—Cat. No. 15336, U.S.N.M.

Female.—Length 1.5 mm. Compared with the original description of *Apanteles* (*Stenopleura*) *chilocida* Viereck this differs as follows: Hind coxæ entirely stramineous; first, dorsal, abdominal plate distinctly wider at apex than the second plate is long down the middle, the second, dorsal plate distinctly shorter than the third, dorsal, abdominal segment, its sides diverging toward the apex, its apical edge nearly twice as long as the basal edge and smooth and polished in part on the apical half, abdomen blackish above and blackish and stramineous beneath.

Allotopotype.—Essentially as in the type except that the antennæ are filiform with the scape dark brown beneath and the second, dorsal plate nearly as wide at base as at apex.

Labeled, "From *Nonagria inferens*, No. 36; T. Shiraki, collector."

APANTELES (STENOPLEURA) SIMPLICIS, new species.

Type-locality.—Taihoku, Formosa.

Type.—Cat. No. 15337, U.S.N.M.

Female.—Length 1.75 mm. Related to *Stenopleura chilocida* Viereck, from Japan, from which it may be known by the stramineous scape, the entirely stramineous hind coxæ, in the first, dorsal plate being distinctly wider at apex than the second plate is long down the middle, in the second, dorsal plate being distinctly shorter than the third, dorsal, abdominal segment, in the dorsum of the abdomen being black or blackish throughout and in the venter being blackish stramineous.

Allotopotype.—Essentially as in the female except that the antennæ are not submoniliform but filiform and in the abdomen being blackish stramineous except for the first, dorsal plate, which is blackish.

Labeled, "From *Chilo simplex*, No. 37; T. Shiraki, collector."

Family ICHNEUMONIDÆ.

ERIPTERNIMORPHA, new genus.

Type-species.—*Eripternimorpha schoenobii*, new species.

Related to *Eripternus* (Foerster) Szepligeti, from which, as represented by *Eripternus radiolatus* (Provancher), it differs chiefly in the malar line being at least as long as the mandibles are wide at base, in the ocelloccipital line being apparently shorter than the greatest

Digitized by Google

diameter of the lateral ocelli, in the mesopleurae being apparently higher than long, in the recurrent vein being interstitial with the transverse cubitus, the areola being quadrate in position with the outer and lower sides defined by suggestions of veins, in the nervellus being branched above the middle, in the nervulus being received by the median cell, in the propodeum being without carinae except for a poorly defined basal and a well-defined apical transverse carina, in the slit-like propodeal spiracles, in the petiole being without a fossa on each side and in the abdomen which is depressed in the male and depressed to fusiform in the female.

ERIPTERNIMORPHA SCHOENOBII, new species.

Type-locality.—Taihoku, Formosa.

Type.—Cat. No. 15338, U.S.N.M.

Female.—Length 8.5 mm.; black, sericeous and with a subtle sculpture; lateral ocelli nearer to the anterior ocellus than to each other but nearer to each other than to the eye margin, front with a carina reaching from between the antennal fossae almost to the anterior ocellus, anterior edge of the clypeus slightly subemarginate mandibles blackish, reddish at extreme base, the basal half striated, palpi dark brown, scape black, pedicel and flagel blackish brown, flagel 28-jointed; prepectal carina not extending to the upper edge of the mesopleurae, wings brownish, stigma and veins dark brown, posterior margin of the mesopleurae reddish as are the mid coxae at base, nearly all of each femur, hind coxae and metapleurae, rest of legs black or blackish, except the fore tibiae, which are stramineous, mid onychia apparently a little longer than the mid metatarsi, fore coxae brownish stramineous beneath, propodeum reddish and separated from the metapleurae by a poorly developed carina, longitudinal propodeal carinae virtually wanting, the basal and apical transverse carinae poorly developed, the lateral longitudinal carinae developed between the apical transverse carinae and the apex of the propodeum; first, abdominal segment with its petiole subcylindrical, with a poorly developed longitudinal carina on each side above but with a distinct carina between it and the ventral segment, reddish at base and ventrally, elsewhere blackish, postpetiole rather depressed, distinctly wider at apex than at base, with a rather well-defined carina which extends from the spiracles toward the apex, the dorsal carina of the petiole prolonged but still less definite on the basal half of the postpetiole, postpetiole reddish stramineous; second, dorsal, abdominal segment apparently two and one-half times as wide at apex as the first is wide at apex and distinctly wider at apex than at base, with pale, oval thyridia that are nearer the base than to the lateral edge and with a polished embossed area between them and the base, the

Digitized by Google

spiracles nearly three times as far from the base as from the lateral edge, second segment reddish along the apical edge; third, dorsal segment reddish except along the apical edge, where it is blackish, apparently more than twice as wide at apex as long down the middle, apical half of the eighth segment whitish, membranous, above; exserted portion of the ovipositor approximately as long as the first dorsal abdominal segment.

Allotype.—Essentially as in the type from which it differs chiefly as follows: Flagellar joints beyond the middle concave beneath, mid coxæ mostly reddish, fore metatarsi mostly stramineous, mid onychia somewhat longer than the mid metatarsi; postpetiole almost parallel sided, blackish on the basal half above; second, dorsal abdominal segment apparently three times as wide at apex as the first is wide at apex, the spiracles nearly five times as far from the base as from the lateral edge, second segment stramineous along the apical edge; apical half of the third, dorsal segment and an apical margin to the fourth and fifth, dorsal segments stramineous, the basal half of the third segment mostly blackish; apical half of the seventh dorsal segment like the apical half of the eighth in the female.

Labeled, "Ex larvæ, *Schoenobius bipunctifera*, January, 1910, No. 32; T. Shiraki, collector."

ZAPARAPHYLAX, new genus.

Type-species.—*Zaparaphylax perinæ*, new species.

This genus agrees with Foerster's description of *Diaglypta*, except in the first, dorsal, abdominal segment, which can hardly be regarded as being broad and robust; ignoring the occipital carina it agrees best with *Paraphylax* (Foerster) Ashmead, from which it differs chiefly in the dorsulum having notauli that are relatively as long and as deep as in *Bathythrix* (Foerster) Howard and in the nervellus being branched below but near its middle. Palpi normal

ZAPARAPHYLAX PERINÆ, new species.

Type-locality.—Taihoku, Formosa.

Type.—Cat. No. 15339, U.S.N.M.

Female.—Length, 2.5 mm. Mostly black and polished; face sericeous, finely, closely punctured; lateral ocelli a little nearer to the eye margin than to each other and nearer to the anterior ocellus than to the eye margin; scape mostly and the pidicel beneath, stramineous, the latter brownish above, flagel blackish, 19-jointed; palpi and basal half of mandibles whitish, apical half of latter brownish; tubercles, tegulæ, and wing base whitish; wings almost colorless, faintly tinted with brown, stigma yellowish, veins brownish; fore and mid legs mostly stramineous, their trochanters whitish, their onychii and the

Digitized by Google

appendages of the latter brownish, their tibiæ with a yellowish annulus medially, hind legs with their coxæ black, their trochanters whitish, their tibiæ brownish, except for a stramineous annulus at base and a yellow annulus in the middle, their tarsi brownish; dorsum of thorax polished, the mesopleuræ sculptured, the propodeum shining and sculptured; abdomen above mostly black and polished, the second segment, however, stramineous, except apically and laterally where it is brownish, the fifth and following, dorsal, abdominal segments with a pale apical edge; exserted portion of the ovipositor apparently as long as the first, dorsal segment.

Allotype.—Essentially as in the type.

Labeled, "Ex larva *Perina nuda*, Dec., 1911; T. Shiraki, collector."

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

A RECENTLY MOUNTED ZEUGLODON SKELETON IN THE UNITED STATES NATIONAL MUSEUM.

By JAMES W. GIDLEY,
Assistant Curator of Fossil Mammals, United States National Museum.

The American zeuglodon, *Basilosaurus cetoides* (Owen) was first brought to the notice of science in 1834, when Harlan, mistaking a few fragments from the Eocene of southeastern Arkansas for the remains of a gigantic reptile, described them under the name *Basilosaurus* [1] (the king reptile). Since that time its skeletal remains have been found in comparative abundance at various localities in the Gulf States and restorations of the great beast were attempted. However, it was not until the two partial skeletons collected by Charles Schuchert, one in 1894 and the other in 1896, from the vicinity of Cocoa, Alabama, were studied and described by F. A. Lucas [2] that any accurate idea of the size and proportions of this great whale-like creature was obtained. These specimens were combined in making up the present skeleton, which constitutes the first approximately correctly assembled one of this interesting species ever to be mounted. These same bones had been partially restored and were exhibited for a number of years in the United States National Museum, but no attempt was made at that time to place them in a natural attitude, farther than to lay the vertebræ out in sequence along a shelf of one of the wall cases. This composite skeleton now occupies a prominent place in the center of the main hall devoted to vertebrate paleontology and is now the only one of its kind on exhibition in any American museum.

The skeleton, as mounted (see pl. 81), is 55 feet in length and comprises 58 elements in the vertebral column, which Lucas classified as follows: Cervicals, 7; thoracics, 13; lumbar-caudals, 38. There seems to be evidence, however, for including still one more vertebra in the dorsal series, making the number 14 instead of 13 for this region and correspondingly decreasing the lumbar series by one. Although

[1] This name, as noted by Lucas, antedates the more appropriate and better-known name, *Zeuglodon*, given by Owen. Hence *Zeuglodon* is here employed in the sense in which whale or elephant is used, as a popular name for the group.

[2] Amer. Naturalist, Aug., 1885, pp. 745-746; Proc. U. S. Nat. Mus., vol. 23, 1900, pp. 327-331.

Digitized by Google

the lumbar, sacral, and anterior caudal vertebræ are quite uniform in size and general character, there is good reason for locating the sacral region between the thirteenth and seventeenth vertebræ counting backward from the last thoracic. Not only were the vestigial pelvic bones and femur, described by Lucas, found in the rock at about this point, but these three vertebræ differ from all the others of the series in the modification of the transverse processes, which are very noticeably thickened and blunted at their outer ends, their appearance suggesting that in some remote ancestral forms these processes articulated with the pelvic bones when the pelvis was proportionately much larger than in the form represented by the present specimen.

Considering these vertebræ as sacrals, the vertebral formula for the skeleton as restored is, cervicals 7, thoracics 14, lumbars 13, sacrals 3, and caudals 21.

As already mentioned by Lucas,[1] the bones in each of these skeletons when found were lying nearly in their natural positions, so that there was little or no chance for error in again placing the elements of the vertebral column after removal from their original bed. Moreover, the specimens admirably supplement each other, the one comprising the anterior portion of the skeleton ending just behind the thoracic region includes but one lumbar vertebra which differs in the character of the transverse processes sufficiently to indicate that it is not duplicated by the first vertebra, a lumbar, of the second specimen. Hence, if any error has been made in the total number of elements included in the vertebral column, it is that they are too few rather than too many.

The skull (see pl. 82) was not complete, but as restored by the writer is given a length of about 5 feet, which length can not be far from correct, since the original parts include nearly all the posterior portion of the cranium with the glenoid fossæ intact and one complete lower ramus, which portions when properly articulate give approximately the true total length of the skull. The snout is greatly elongated and the teeth highly specialized, but otherwise the skull presents many features of the more primitive carnivores and does not in the least, except perhaps in the form of the anterior teeth, suggest any of the whales. The lambdoidal crest is greatly expanded for the attachment of heavy muscles, and the brain case is comparatively large, otherwise the posterior portion of the skull resembles in many features that of a large creodont. This has led some good authorities to believe that the zeuglodons were descendants of some branch of the creodonts.

The fore limbs (see fig. 1, p. 651) are much modified and in some degree cetaceanlike, at least as regards the scapula. The humerus is

[1] Proc. U. S. Nat. Mus., vol. 23, 1900, p. 321.

Digitized by Google

short and heavy with a well developed deltoid ridge, reaching well below the middle of the shaft. A small portion of the shaft is missing and as here restored is probably somewhat too long. This element is not at all cetaceanlike in character. The bones of the forearm are flattened laterally and articulate with each other as they do in the whales and sea lions, resembling somewhat more nearly those of the latter. The manus is not known, but judging from modifications of the radius and ulna, it was evidently highly specialized and paddle or flipper like as in the whales and sea lions. The form and arrangement of these distal elements as here restored (see fig. 1) are necessarily in great degree conjectural, the corresponding parts in both the whale and the sea lion being used as a guide in modeling them. The fact that the known forefoot elements of the closely related genus *Dourdon*, a few phalanges of which are preserved with one of the specimens (No. 4679) in the United States National Museum, resemble so much more those of the sea lions than they do those of the whales, seems to justify including more sea lion than whale like characters in restoring the paddles. Thus digit I, the hallux, is shortened, and digits II and III are made longest and heaviest of the series.

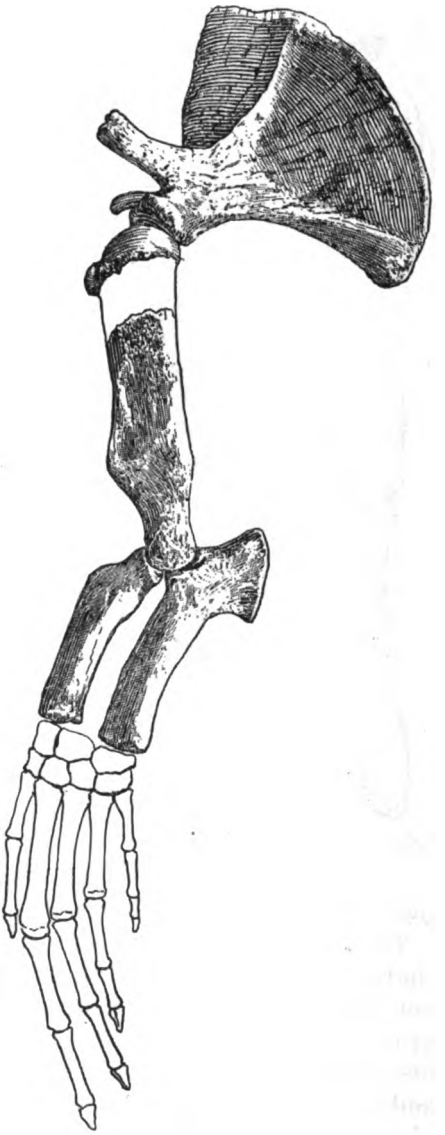


FIG. 1.—FORE LIMB OF AMERICAN ZEUGLODON. ABOUT $\frac{1}{12}$ NATURAL SIZE.

The vestigial pelvic bones and femur, all that is known of the hind limbs, have been fully described by Lucas[1] and are mentioned and again figured here (see figs. 2 and 3, p. 652) because of the doubt which

[1] Proc. U. S. Nat. Mus., vol. 23, 1900, p. 329, pls. 5-7.

Digitized by Google

has been created as to their proper association with the skeleton to which they were supposed to belong. Abel, in an article published in 1906,[1] contended that these bones were the corocoids of a large bird to which he gave the name *Alabamornis gigantea*. A careful restudy of these elements, however, leaves no doubt as to their mammalian characteristics and no reason to assume that they do not properly belong to the skeleton with which they were found associated. While they evince an extremely atrophied state, the acetabulum plainly retains traces of the cotyloid notch and the pit for the attachment of the ligamentum teres (see fig. 2, p. 652), while the bone is considerably thickened in this region. Also, the proximal end of the femur (see fig. 3, p. 652) shows evidence of having been capped with an epiphysis. Not having the actual bones to examine Abel doubtless was led to a wrong interpretation of the plates published by Lucas, because they do not show very clearly the essential characters of the bones. This is due to the fact that the bone surfaces are pitted and roughened through imperfect preservation and the reproductions, which are from photographs, are perhaps somewhat confusing.

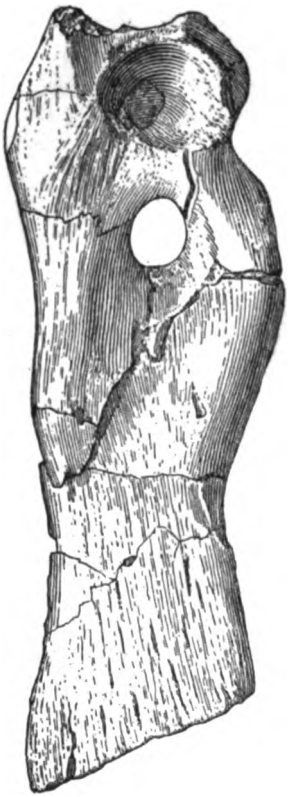


FIG. 2.—PELVIC BONE OF AMERICAN ZEUGLODON. ⅛ NATURAL SIZE.

FIG. 3.—FEMUR OF AMERICAN ZEUGLODON. ⅛ NATURAL SIZE.

The anterior portion of the vertebral column, including the cervicals and first seven thoracics, are not highly specialized and are typically mammalian in character. But from this point backward to the first lumbars, the vertebræ rapidly gaining in size and increased length of their centra, show a degree of specialization that is unique. The vertebræ from the beginning of the lumbar region to about the ninth from the end of the tail have exceedingly long, heavy centra and relatively small neural arches, and are comparatively uniform in size and general appear-

[1] Centralbl. Min. Geol. Paleont., p. 456.

Digitized by Google

ance throughout. Here the length of centra average about 15 inches, as compared with about 4 inches for the first thoracic. This gives to the skeleton a very remarkable appearance, viewed as a whole. It may be said to resemble that of a whale with an exceedingly small head, comparatively small thorax, and very greatly lengthened lumbar and caudal regions. The zygapophyses do not articulate with those of the neighboring vertebræ, except in the cervical and anterior thoracic vertebræ, and from the eighth thoracic backward to where they disappear near the end of the tail, are separated by intervals of about 5 to 7 inches, the anterior pairs being modified, apparently, for the attachment of the heavy back muscles, while the neural spines are correspondingly reduced. Thus for the greater part of the length of the vertebral column the vertebræ articulated only by their centra which are nearly circular at the ends and were probably capped by intervertebral cartilage disks of some thickness. This constitutes an arrangement which must have given to the long, slender body a perfectly free motion in almost any direction and doubtless rendered this great creature capable of diving and turning at will, or of swimming forward at tremendous speed. The short, stout, flexible neck, which doubtless was heavily muscled, also denotes agility in turning. In fact, the whole mechanical construction of the animal seems to denote that he was a most powerful swimmer, his entire development being especially adapted to rapid locomotion. If, as is indicated by the dentition, which seems admirably fitted for seizing and holding his prey, he fed on large swiftly swimming fishes, or other sea-living creatures, his very existence probably depended on speed.

It may be of interest here to recall the grotesque restoration by Koch which he constructed from zeuglodon bones and which several years ago was exhibited in various museums of this country. This restoration, which Koch called the Hydrarchos, was made up of the bones of many individuals, in which were included far too great a number of vertebræ and ribs, giving not only too great a relative length to the neck and thoracic region, but a very much exaggerated length to the whole creature. The history of this restoration is given concisely in a letter written by I. A. Latham to Prof. J. D. Dana in 1895, an extract from which is here quoted:

> I have your kind letter of the 27th asking about the Zeuglodon skeleton, lost in the great "Chicago fire." It had been brought from St. Louis some years before, and was the same discovered by Dr. Albert Koch on the plantation of Colonel Price, situated near the line of Choctaw and Washington Counties, Alabama. It was removed to Dresden in Saxony, where after eight months labor, it was reduced in length from 114 to 96 feet. It was afterwards brought back to this country and purchased by the proprietor of a museum at St. Louis, from Doctor Koch. At Chicago it was one of the chief attractions of "Wood's Museum."

Digitized by Google

Although much has been written of the zeuglodons by various investigators who have compared in detail its various anatomical features and discussed at length its relationships, there still exists wide difference of opinion among authorities regarding the true affinities of the group. One point of weakness in all these discussions is the absence of any known intermediary forms to connect them with any of the other groups to which they may seem allied.

As has been pointed out by various authors,[1] the zeuglodons possess many primitive characters, especially in the skull and teeth, in which they resemble either the seals or the more ancient creodonts. In other characters, the ones in which they are more highly specialized, they resemble the whales in some respects; while in others, as in the modification of the arm, they suggest the sea lions. There is nothing, however, to warrant placing them in any intermediate position between these at present widely separated groups of mammals, for at the time of their apparent extinction in the Eocene they had already outstripped in the development of certain important modifications what has been accomplished by any of the modern cetaceans, hence could not have stood in any direct ancestral relationship to the latter, while the primitive features which they retained are too generalized in character to especially connect them with any of the more archaic groups of mammals. Furthermore, there is at present too much obscurity concerning the origin of the whales to arrive at anything definite regarding the derivation of the zeuglodons from any ancestral form of that group.

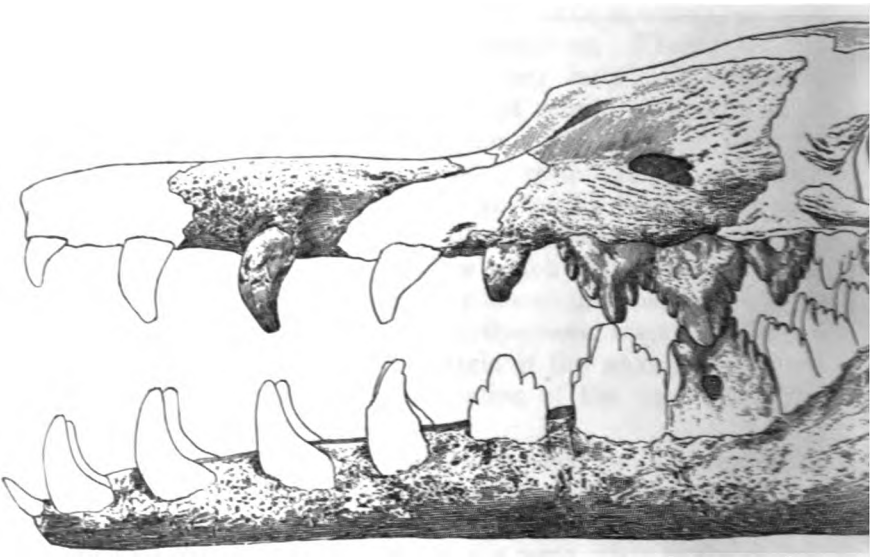
The high degree of specialization which they had attained in the development of the body and limbs, combined with the retention of so many primitive characters, would indicate a very ancient origin for these animals, and if derived from the same stock as the seals or sea lions or direct from the early creodonts, their branching-off point must have dated back to a time most remote, certainly before the various natural groups of the creodonts appearing in the early Eocene were sufficiently differentiated to be recognized.

[1] See Thompson, On the Systematic position of Zeuglodon, Univ. Dundee, June, 1890; Dames, Paleont. Abhandl., 1894, pp. 189–219; Zittel, Grundzüge der Paleont.; and others.

Digitized by Google

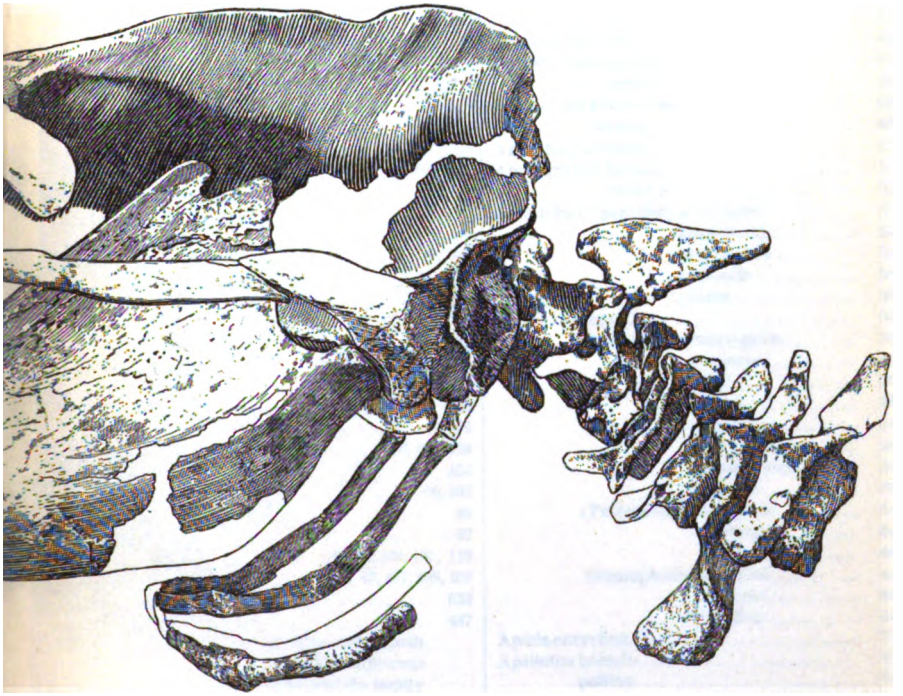
Digitized by Google

U. S. NATIONAL MUSEUM



SKULL AND CERVICAL VERTEBRÆ
FOR DESC

Digitized by Google



ZEUGLODON. (ABOUT ⅛ NAT. SIZE.)

SEE PAGE 650.

Digitized by Google

Digitized by Google

INDEX.

Page.

Abylopsis eschscholtzii ... 69
tetragona ... 68, 108, 109
Acrididæ, collection of, made in Peru ... 177
Actinian of the genus Edwardsiella from southern California, a new species of ... 551
Aegina ... 58
alternans ... 58, 59
citrea ... 58, 59
rhodina ... 58
rosea ... 58, 59, 103
species? ... 59
Aeginopsis laurentii ... 103, 107
Aeginura ... 60
grimaldii ... 61, 103
weberi ... 61
Aequorea æquorea ... 37, 38, 102
var. æquorea ... 38
albida ... 40
albida ... 38
floridana ... 37, 38
forskalea ... 38
globosa ... 38
macrodactylum ... 39
norwegica ... 38
pensile ... 41, 108, 109
Ærophilopsis ... 555
Agalma okeni ... 79, 108
Agalmoides eschscholtzii ... 69
Agantha ... 42
digitale ... 43, 103, 106, 107, 110
Aglaura hemistoma ... 42, 107, 108, 109
Alabamornis gigantea ... 652
Aldrovandia ... 487
Alexander, Charles P. A revision of the South American dipterous insects of the family Ptychopteridæ ... 331
A synopsis of part of the Neotropical crane-flies of the subfamily Limnobinæ ... 481
Alloionema ellinoræ ... 52
Alloniscus, species ... 340
Amastus edaphus ... 286
Amblyscirtes tutolia ... 281
Ammalo tenerosa ... 286
Ammobia spinigra ... 451
Ammochilostoma rotundata ... 637
Amusus kirschianus ... 357
Amycosoma chilonis ... 640
Anaplecta abortiva ... 603
Ansulacomera maculicornis ... 354
sulcata ... 355
Anchorella laciniata ... 259
Anchotatus peruvianus ... 177

Page.

Androcloema ornatum ... 487
spinosa ... 487
Angufila aneitensis ... 359
japonica ... 359
manabei ... 359
Anisitsia tinocchacæ ... 469
Anisodes mesoturbata ... 313
poliotaria ... 309
Anthomyia leucosticta ... 627
ornata ... 631
Anuretes parvulus ... 223
Anurogryllus fuscus ... 356
muticus ... 356
Apanteles (Apanteles) aristotelis ... 556
laspeyresiæ ... 556
megathymi ... 557
phycodis ... 557
plusiæ ... 557
empretis ... 562
(Propanteles) congregatus ... 561
empretis ... 562
fiskei ... 562
griffini ... 561
hemileucæ ... 562
læviceps ... 561
mayaguesensis ... 563
schizuræ ... 562
(Protapanteles) formosæ ... 642
narangæ ... 642
stauropi ... 642
(Stenopleura) chilocida ... 645
nonagriæ ... 645
simplicis ... 645
Apicia entychon ... 314
Aptilotus borealis ... 361
politus ... 362
Arachnophroctonus ... 441
xanthropterus ... 442
Arbela naida ... 324
Archangelopsis typica ... 79, 108
Argopteron dividuum ... 281
Argulidæ ... 193
Aricia sociella ... 627
Artacolax palleucus ... 200
Asobara orientalis ... 639
Aspidosiphon ... 374, 424
klunzingeri ... 427
mirabilis ... 424, 426
mulleri ... 424
parvulus ... 375, 376, 425
speciosus ... 376, 426
truncatus ... 374
Atabarba pleuralis ... 504
puella ... 506
Atanycolimorpha ... 557
winnemannæ ... 557

Digitized by Google

Page.

Atarba pleuralis 503
pusilla 503, 506
Atolla 86
alexandri 86
tenella 86
wyvillei 86, 103, 106
Aurelia 98
aurita 99, 103, 106, 110
hyalina 100
limbata 99, 103, 107, 110
Autolyca picturata 350
transversata 350
Automeris obscura 134
Averrunous enmeiane 459
Bacteria (Bacunculus) striatus 612
Bagisara desmura 294
oula 293
xan 294
Balleya australis 293
ophthalmica 293
restitans 293
Ballovia cistipennis 323
Barathrodemus nasutus 152
Basilosaurus cetoides 649
Bassia bassensis 69, 106
Bassogigas 153
aequatoris 153
pterotus 154
Bassosetus compressus 157
elongatus 157
robustus 156, 158
Bassus (Aerophilopsis) erythrogaster 555
Bathystoma timator 212
Biareolina neglecta 346
Bigelow, Henry B. Medusae and siphonophorae collected by the U. S. Fisheries steamer "Albatross" in the northwestern Pacific, 1906 1
Bison bison 585
kansensis 584
Blatella dilatata 603
peruana 349
stylata 349
Blatta orientalis 602
rhombifolia 602
supellectilium 603
tinocchaca 350
Blattidæ 600
Bolivina beyrichii 634
sculpturata 635
Bombyx ebalus 133
metabus 133
netrix 134
obsoleta 133
Bomolochus attenuatus 198
nothrus 195
Borboridæ, new species of American flies of the family 361
Borborus articus 367
brevisetus 365
lacteipennis 366
neglectus 364
Botrynema brucei 52
ellinorse 53, 103
Botys medonalis 319
pyrenealis 319

Page.

Bougainvillea bougainvillea 103, 106
britannica 9
fulva 109
mertensi 9
superciliaris 8, 9, 103
Brachiella concava 262
(Bracon) Antanycolimorpha prevancheri 557
(Bracon) Habrobracon xanthonotus 641
Bracon mavoritus 558
(Melanobracon) webbi 558
novitus 558
rugator 558
ventralis 561
Branchiostoma californiense 458
Brotulidæ and Carapidæ from the Philippine Islands and the Dutch East Indies, descriptions of new genera and species of fishes of the families 135
Bruner, Lawrence. Results of the Yale Peruvian expedition of 1911. Orthoptera (Acrididæ-short-horned locusts) 177
Bythites 172
lepidogenys 172
Cænocharis ouden 309
Calidota calostoma 285
California, coast of, rare fishes from 455
California, southern, a new species of actinian from 561
Caligus abbreviatus 216, 220
afurcatus 215
atromaculatus 214
balistæ 208, 216
enormis 216, 217
hæmulonis 208
irritans 210, 214
isonyx 208
monacanthi 220
productus 208, 220
robustus 212
suffuscus 219
tenax 208
Callinema ornata 96
Callosphex erythrogastra 480
Calomathetes 303
halmaphylla 303
Calycopsis bigelowi 23
chuni 23
nematophora 23, 103, 106
simulans 23, 24
typa 21, 23
Cambogia agrotea 306
operbula 307
saria 307
Campometra distilla 300
Campsomeris (Campsomeris) similaris 448
Campylonerus rugator 558
Cancrincola 264
jamaicensis 264
Carapidæ and Brotulidæ from the Philippine Islands and the Dutch East Indies, descriptions of new genera and species of fishes of the families 135
Catablema multicirrata 19, 103, 106, 107
vesicaria 19, 103, 110
var. nodulosa 17
Catastyx 109

Digitized by Google

Page.

Catætyx platycephalus ... 169
Catoclothis gymnopomparia ... 306
Caudell, A. N. Notes on Nearctic orthopterous insects. I. Nonsaltatorial forms ... 595
Results of the Yale Peruvian expedition of 1911. Orthoptera (exclusive of Acrididæ) ... 347
Celiptera surrufula ... 299
Cephalocœma costulata ... 177
vittata ... 177
Cephea ... 101
cephea, var. setouchiana ... 101
cœrulescens ... 101
papua ... 100
setouchiana ... 101
Ceropales basirufus ... 443
Chalcopasta chalcocraspedon ... 297
Charybdea bitentaculata ... 63
rastonii ... 109
Chelisoches morio ... 597
Chelonus aculeatus ... 641
(Chelonella) bussyi ... 558
Chilara taylori ... 460
Chironomus hirticornis ... 532
Chlorippe wilmattae ... 343
Chorisoneura peruana ... 347
plocea ... 604
texensis ... 604
Christolimorpha ... 564
plesius ... 564
ruficeps ... 564
Chrysaora helvola ... 103, 106, 107
hysoscela ... 104
melanaster ... 90, 104
Chrysis (Tetrachrysis) rugosa ... 444
Chuniphyes multidentata ... 73, 108
Cicinnus lygia ... 317
Cirphis striguscula ... 288
Clausophyes galatea ... 71, 108
Clavella (Anchorella) laciniata ... 259
inversa ... 261
papua ... 109
Clavulina primæva ... 635
rotindata ... 635
Clydonodozuz ... 487
Cockerell, T. D. A. Some fossil insects from Florissant, Colorado ... 341
Codonium princeps ... 5
Cœlinidea ... 555
Cœlinius longulus ... 555
Cœloidimorpha ... 558
Cœlomyia subpellucens ... 631
Cœnocalpe morrisata ... 314
sistenata ... 314
Collapsis achilis ... 86
Colobonema typicum ... 46, 108
Colorado, fossil insects from ... 341
Conchœcia spinirostris ... 268
Coryne eximia ... 4
Crabs, land, and fishes, crustacean parasites of, from the West Indies ... 189
Crabs, new species of, belonging to the family Ocypodidæ ... 615

Page.

Crane-flies, a synopsis of part of the Neotropical, of the subfamily Limnobinæ ... 481
Crassomicrodus fenestratus ... 558
Crocidolomia ochritacta ... 319
Crossota ... 47
alba ... 49, 108
brunnea ... 50, 51
var. norvegica ... 48, 105, 106
norvegica ... 48
pedunculata ... 51, 106
Cryptocercus punctulatus ... 605
Cryptocheilus peruvianus ... 440
Cryptolabis bisinuata ... 509
paradoxa ... 509
tropicalis ... 509
Cryptus armatus ... 565
monticola ... 567
nebraskensis ... 566
similis ... 565
Crystallodes vitreus ... 79
Crystallomia polygonata ... 79
Ctedonia ... 542
bicolor ... 542
bipunctulata ... 542
flavipennis ... 542
fusca ... 543
pictipennis ... 542
Ctenacroscelis ... 496
Cumainocloidus ... 179
cordilleræ ... 180
Cunina peregrina ... 58, 109
Cunoctona grimaldi, var. munda ... 61
guinensis ... 61
obscura ... 61
Cushman, Joseph A. New Textulariidæ and other arenaceous foraminifera from the Philippine Islands and contiguous waters. 633
Cyanea ... 92
arctica ... 106
capillata ... 107
var. capillata ... 93, 103
nozakii ... 93
ferruginea ... 92
nozakii ... 93
postelsii ... 92
variety ? ... 94
Cylindrotoma ornatissima ... 331
Cylloceria marginator ... 469
tincochacæ ... 469
Cypridina mediterranea ... 268, 270
parasitica ... 269
Cytiæs vulgaris ... 109
Dactylolabis consperse ... 487, 495
Dactylometra ... 90
africana ... 91
ferruginaster ... 91, 92
lactea ... 91
longicirrha ... 91, 92
pacifica ... 91, 92, 107, 109
var. ferruginaster ... 92
quinquecirrha ... 91
species? ... 106
Dasylophia rufitincta ... 303
Dasyposoma bigra ... 350
Dasyscelus, species ... 351

Digitized by Google

Page.

Deilinia gracilosa ... 311
Dendrostoma ... 378, 416
  alutaceum ... 374, 375, 376, 416, 417, 425
  blandum ... 416
  peruvianum ... 374, 416
  pinnifolium ... 375, 416
  spinifer ... 416
Dentigryps ... 221
  curtus ... 221, 222
Diachasmimorpha comperei ... 641
  crawfordi ... 641
Diapetimorpha ... 564
Diaphoromera carolina ... 611
  femorata ... 613
  mesiliana ... 610
  persimilis ... 610
Diastema panteles ... 298
Diastictis lamitaria ... 313
Dichroplus peruvianus ... 184
  auriventris ... 184
  punctulatus ... 185
  species ... 185
Dicrolene intronigra ... 145
  longimana ... 144
  tristis ... 145
Diedronotus angulatus ... 181
Digonodes maidiena ... 311
Diphyes appendiculata ... 76, 106, 108, 109
  arctica ... 76, 77, 104, 107, 110
  bassensis ... 69
  contorta ... 76, 108
  fowleri ... 75
  kochii ... 74
  mitra ... 78
  ovata ... 70, 71
  spiralis ... 76, 77, 78, 108
  subtiloides ... 73, 74
  truncata ... 1, 73, 74, 104, 107, 108
Diphyopsis chamissonis ... 78, 108
  dispar ... 77, 108, 109
  mitra ... 78, 108
  weberi ... 78
Diplacanthopoma ... 166
  rivers-andersoni ... 167
  (Sarcocara) brunnea ... 167, 170
  squamiceps ... 169, 170
Diplocraspedon limbata ... 99
Diptera, new, of the genus Fannia ... 621
  new species of, in the National Museum collection ... 461
Doratoperas bystrapegus ... 320
Doru exilis ... 597
  linearis ... 597
  lutelpennis ... 597
Dutch East Indies, new genera and species of fishes of the families Brotulidae and Carapidae from the Philippine Islands and ... 135
Dyar, Harrison G. Descriptions of new lepidoptera chiefly from Mexico ... 279
  Descriptions of new species of Saturnian moths in the collection of the United States National Museum ... 121
Dysodia monava ... 317
Edia microstagma ... 320

Page.

Edwardsiella, description of a new species of actinian of the genus, from southern California ... 551
  adenensis ... 552
  californica ... 551
  pudica ... 552
Eel, new, from Japan, description of ... 359
Elphosoma (Brachixiphosoma) insularis ... 564
  nigrovittatum ... 564
Elaphroptera atrata ... 447
Electrocephalus strahlendorffi ... 346
Elliptera alexanderi ... 503
Enchelybrotula ... 154
  paucidens ... 154
Eneoptera surinamensis ... 357
Eniocspilus heliothidis ... 565
  reticulatus ... 565
Eobruneria ... 343
  tessellata ... 343
Epibulia monoica ... 70
Epilampra ... 349
Epimolis satrephica ... 296
Epiphragma ... 535
  adsperso ... 536, 541
  buscki ... 540
  circinata ... 536
  delicatula ... 536
  fabricii ... 488, 536
  fascipennis ... 535
  histrio ... 535
  imitans ... 535, 536
  nebulosa ... 536
  punctulatissima ... 536
  pupillata ... 536, 539
  solatrix ... 536
  varia ... 536
Epirhyssalus atriceps ... 559
  loxoteniae ... 559
  similis ... 559
Equus caballus ... 578, 589
  complicatus ... 570, 572, 577, 591
  excelsus ... 580, 583, 591, 592
  fraternus ... 569, 571, 572
  laurentius ... 584, 585, 589, 590
  leidyi ... 572
  littoralis ... 575
  niobrarensis ... 576, 577, 583, 589, 590, 592, 593
  tau ... 576
Eretmichthys ... 155
Ergasilus longipalpus ... 193
  myctarothes ... 194
Ericoelinius ... 555
Eriocera fasciata ... 488
  longistyla ... 488
  willistoni ... 488
Erioptera annulipes ... 513
  (Empeda) nigrolineata ... 520
  immaculata ... 519
  (Mesocyphona) annulipes ... 513
  bicinctipes ... 519
  caloptera, femora-nigra ... 518
  costalis ... 517
  eiseni ... 516
  hirsutipes ... 512
  immaculata ... 518
  knabi ... 515

Digitized by Google

Page.

Erioptera (Mesocyphona) parva, var. brasiliensis 514
splendida 514
nigrolineata, var. pubescens 520
stigmatica 520
Eriopyga cracerdota 290
crenulata 290, 291
cynica 291
dolia 291
enages 291
lanaris 291
loliopopa 289
oache 291
ultimella 291
vesquesa 290
Eripternimorpha schoenobii 645, 646
Eripternus radiolatus 645
Ethaemorpha 565
Euchaetias cressida 284
epagoga 285
expressa 285
mitis 285
rhadia 285
Eurota descintes 284
Euryphorus coryphaenae 225
Eustrotia chuza 298
mochensis 298
pulmona 298
Uutelia amatrix 299
Eutima levuka 109
Eutimalphes indicans 34
pretiosa 34
Eutonina elephas 34
indicans 34, 103
socialis 34, 104
Eutrichopsis oscinidis 559
Euzophera griselda 322
immorella 322
Evergestis dyaralis 319
Fannia, new diptera of the genus 621
aethiops 628
benjamini 625
canicularis 621
conspicua 624
femoralis 627
genualis 630
grandis 623
howardi 626
kowarzi 630
leucosticta 627
morrisoni 627
ornata 631
postica 627
pretiosa 630
pusio 623
sociella 627
tibialis 461
trimaculata 623
vittata 623
Farigia malomen 304
Fishes and land crabs, crustacean parasites of, from the West Indies 189
Fishes of the families Brotulidae and Carapidae from the Philippine Islands and the Dutch East Indies, new genera and species of 135
Fishes of the genus Triglops, two new 465

Page.

Fishes, rare Californian, notes on 455
Flies, new species of, belonging to the family Borboridae 361
Foraminifera, arenaceous, from the Philippine Islands and contiguous waters 633
Forficula auricularia 596
pulchella 599
Forficulidae 595
Forskalea, species ? 78
Furcomyia bigoti 488
blanchardi 488
chilensis 487
subandina 488
Furina rufithorax 522
Galeolaria australis 69, 108
monoica 70, 108
truncata 73
Galerucella luteola 623
Gaudryina attenuata 636
filiformis 636
pseudofiliformis 636
robusta 636
Geranomyia annulata 487
enderleini 487
philippii 487
virescens 487
Gerould, John Hiram. Sipunculids of the eastern coast of North America 373
Geryones elephas 56
proboscidalis 56, 108, 109
tetraphylla 55
Gidley, James W. A recently mounted zeuglodon skeleton in the United States National Museum 649
Gilbert, Charles H. Descriptions of two new fishes of the genus Triglops from the Atlantic coast of North America 465
Gingla raconica 316
thyesta 316
Givira felicoma 323
flavescens 324
gabriel 323
Gleba hippopus 66
Glympis phoenicimon 302
Glyptophidium argenteum 162
lucidum 161
macropus 163
oceanium 162
Gnophomyia aperta 521
caloptera 521
ferruginea 521
hirsuta 521, 523
limnobia ligricola 522
luctuosa 522
magnifica 521, 522
nigrina 521
osten sackeni 521
rufithorax 521, 522
subhyalina 521, 523
tristissima 521
Gonionemus suvaensis 109
vertens 106
var. depressum 103, 109
Gonomyia 503
antarctica 488
caudata 503

Digitized by Google

	Page.
Gonomyia galactoptera	503
(Gonomyia) delicata	506
unicolor	507
(Leiponeura) pleuralis	504
puella	506
puer	506
pleuralis	504
variegata	488
Grammonus	168
robustus	168
Gryllus, species	357
Habrobracon mali	641
Haccadecomma ambiguum	96
Hadena lithaphania	289
Haliclystus auricula	103, 110
stejnegeri	103
Halicreas minimum	52
papillosum	52, 103
var. antarcticum	52
Halicreasidæ papillosum	52
Halistaura cellularia	30, 106
Harpactopus edwardsi	451
Hatschekia albirubra	239
(Clavella) labracis	246
insolita	245
iridescens	248
linearis	246
oblonga	240, 242
uncata	243
Hay, Oliver P. Notes on some fossil horses, with descriptions of four new species	569
Helobia hybrida	511
macroptera	511
Hemerobiidæ	341
Hephthocara crassiceps	174
simum	175
Heterocampa atrax	304
dolorosa	304
Heterospilus sclandriae	559
Heterotiara anonyma	25, 103, 106
minor	27
Hippocrene superciliaris	9
Hippopodius hippopus	66, 108
Hollister, N. A synopsis of the American minks	471
Holocompsa collaris	604
Holorusia rubiginosa	486
Homalomyia brevis	627
femoralis	627
flavibasis	629
flavivaria	621, 631
genualis	630
kowarzi	630
postica	627
pretiosa	630
trimaculata	623
Homoeonema amplum	44
macrogaster	44
militare	44
platygonon	44
typicum	46
Homostolus	146
acer	147
Hoplolibethra tuberculata	613
Hormius trilineatus	559
Horses, fossil, four new species of	569

	Page.
Hybocodon chilensis	5
christinae	5, 6
occidentalis	5
prolifer	5, 6, 103, 106
unicus	5
Hydriomene grettaria	306
potosiata	305
Hydroecia arnymai	296
Hygrochroma hyalopuncta	312
Hylesia ascodex	127
athlia	131
bulaea	133
cedomnibus	132
coadjutor	282
coëx	128
coinopus	283
composita	131
cressida	132
domina	133
ebalus	133
euphemia	133
fulviventris	133
gyrex	125
index	126
iola	282
leilex	127
lilacina	133
liturex	130
livex	129
lolamex	130
metabus	133
molpex	130
mortifex	130
murex	127
murmur	128
mymex	125
mystica	131
netrix	134
nigridorsata	128
obsoleta	133
ochrifex	126
ogratex	128
orbifex	129
pauper	131
pollex	126
praeda	128
remex	129
rex	129, 130
schausi	130
solvex	132
subaurea	282
subcana	129
tapabex	125
vagans	134
valvex	127
vindex	132
violascens	134
Hymenoptera of the superfamilies Vespoidea and Sphecoidea obtained by the Yale Peruvian expedition	439
Hypenodes macula	296
Hypenopsis	296
macula	296
Hyperchiria vagans	134
Hypodynerus huancabambae	445
nigricornis	445

Digitized by Google

Page.

Hypodynerus tapiensis ... 445
vestitus ... 445
Hypopleuron ... 164
caninum ... 165
Hyssia pseudochroma ... 288
Hysterobolus ... 559
mallochi ... 560
Icelinus quadriseriatus ... 458
Ichneumonoidea collected by the Yale Peruvian expedition of 1911 ... 469
Ichneumon-flies, descriptions of six new genera and twelve new species of ... 639
descriptions of ten new genera and twenty-three new species of ... 555
Icriomastax ... 486
Insects, dipterous, of the family Ptychopteridæ, a revision of ... 331
Insects, fossil, from Florissant, Colorado ... 341
Nearctic orthopterous, notes on ... 595
Ischnoptera ignobilis ... 348
pampaconas ... 348
Ischnothrix ... 525
setherea ... 525
Isodontia bipunctata ... 452
Isopods, new terrestrial, from Costa Rica ... 337
Itoplectis evetriae ... 565
Janus abbreviatus ... 346
disperditus ... 346
integer ... 346
Japan, a new eel from, description of ... 359
Jordan, David Starr. Description of Anguilla manabei, a new eel from Japan ... 359
Kansas, a new meteorite from near Cullison, Pratt County ... 325
Kuragea depressa ... 91, 92
Labia brunnea ... 598
burgessi ... 598
curvicauda ... 598
minor ... 598
Lachnocera ... 502
delicatula ... 502
Lacosoma julietta ... 317
medalla ... 316
otalla ... 317
rosea ... 317
Lamprogrammus macropterus ... 163
Laodice cellularia ... 30
fijiana ... 109
Latindia schwarzi ... 605
Lecteria ... 493
armillaris ... 497
conspersa ... 495
matto-grossae ... 496
obliterata ... 493, 494
obscura ... 487, 495
Lepeophtheirus cossyphi ... 220
dissimulatus ... 221, 222
Lepidoptera, new, from Mexico ... 279
Lernæolophus hemiramphi ... 251
recurvus ... 252
striatus ... 254
sultanus ... 252
Lernæopenna blainvillii ... 251

Page.

Lernanthropus angulatus ... 227
frondeus ... 230
giganteus ... 227
gisleri ... 228
kroyeri ... 228
obscurus ... 232
pagodus ... 228
spiculatus ... 233
Libellulapis antiquorum ... 345, 346
wilmattæ ... 344, 346
Libethra confusa ... 613
Limnobia adspersa ... 541
armillaris ... 488, 493, 497
calopus ... 488, 493, 497
chrysoptera ... 488
guttata ... 487
longicollis ... 488
maculata ... 537
obscura ... 495
reciproca ... 488
stigmatica ... 488
tenebrosa ... 488
trentepohlii ... 499
Limnobinæ, a synopsis of part of the Neotropical crane-flies of the subfamily ... 481
Limnophila ... 543
adusta ... 548
cineracea ... 546
epiphragmoides ... 543
guttulatissima ... 546
lentoides ... 545
lutea ... 543, 547
marmorata ... 487
nacrea ... 544
Limosina lugubrina ... 369
niveipennis ... 370
parva ... 371
rotundipennis ... 370
trochanteratus ... 462
Liriope ... 54
tetraphylla ... 55, 107, 108, 109
Litaneutria skinneri ... 606
Locusts, short-horned, collection of, made in Peru ... 177
Lophiodes infrabrunneus ... 145
Luciobrotula bartschi ... 170, 171
Lustela lutreocephala ... 473
Lutra vison ... 472
Lutreola lutreocephala ... 473
vison ... 472, 475
energumenos ... 476
ingens ... 477
lacustris ... 475
lutreocephalus ... 473
melampeplus ... 477
nesolestes ... 476
Lygranthoecia amblys ... 287
McMurrich, J. Playfair. Description of a new species of actinian of the genus Edwardsiella from southern California ... 551
Macrocentrus (Amicroplus) crambivorus ... 556
plesius ... 556
Macrophthalmus bicarinatus ... 619
crinitus ... 618
pacificus ... 618, 619

Digitized by Google

Page.

Malloch, J. R. Descriptions of new species of American flies of the family Borboridæ 361
Notes on some American dipteras of the genus Fannia, with descriptions of new species. 621
Two new species of diptera in the United States National Museum collection 461
Manomera orthostylus 612
Mantidæ 605
Mantoida maya 608
Mastigias papua 100, 109
physophora 100
Mastigopterus 158
imperator 159
prætor 160
Matigramma psegmapteryx 301
Meator rubatra 12, 103, 105
Medusa æquorea 38
aurita 99
capillata 93
digitale 43
panopyra 88
patura 38
pensile 41
proboscidalis 56
Medusæ and siphonophoræ collected by the "Albatross" in the northwestern Pacific, 1906 1
Megathymus rethon 282
Meleaba antithetes 308
uranis 308
Melicertum campanula 110
georgicum 106
Melitara parabates 322
Meloscirtus australis 178
montanus 178
Menopsimus caducus 295
Merluccius productus 165
Merrill, George P. A newly found meteorite from near Cullison, Pratt County, Kansas .. 325
Meskea dyspteraria 317
horror 317
subapicula 317
Mesochorus plusiæphilus 566
Mesonema victoria 38
Mesoscia dumilla 316
? cuteta 316
Mesostenimorpha 566
Meteorite, new, from Cullison, Kansas 325
Meteorus hyphantriæ 560
laphygmæ 560
Mexico, new lepidoptera chiefly from 279
Micrathetis dasarada 295
Micrattacus bulaea 133
fulviventris 133
violascens 134
Microbracon hispæ 642
rhyssemati 642
Microcentrum peruvianus 356
Micromonodes mochensis 298
Microstylus setouchianus 101
Microxydia pulverosa 313
Midias lobodes 225

Page.

Minks, American, a synopsis of the 471
Miselia caloscotina 288
transvitta 287
Molophilus guatemalensis 511
thaumastopodus 510
Momaphana annadora 293
brillians 292
sylvia 292
Mongoma 499
disjuncta 499, 500
extensa 501
longifusa 502
manea 502
niveitarsis 501
Mongomella cariniceps 487
gracilis 487
zambesiæ 487
Monodes cassida 298
Monogonogastra ventralis 561
Monomitopus 148
garmani 151
longiceps 149
microlepis 150
nigripinnis 149, 151
pallidus 148
Moths, Saturnian, new species of, in the U. S. National Museum 121
Muggiaea kochii 1, 73
Mustela lutensis 474
macrodon 478
minx 472
(Putorius) vison 472
vison 472
antiquus 478
energumenos 476, 477
ingens 475, 477
lacustris 475, 478
letifera 473, 475
lutensis 474
lutreocephala 473, 474
melampeplus 477, 478
nesolestes 476
vison 472
vulgivaga 474
winingus 472, 473
Myosoma pilosipes 640
Myrmicomorpha 566
Nannotettix guentheri 351
paltaybamba 351
peruvianus 353
species 354
Nauphota marginalis 603
pallida 603
Nausithöe punctata 85, 108
Nectarina bilineolata, var. mœbiana 447
Nectodroma reticulata 65, 108
Nectopyramis diomedæ 63, 107
Nemesis versicolor 236
Nemopsis dofleini 109
Neobythites 138
fasciatus 144
longipes 139
macrops 141, 144
sivicola 144
unimaculatus 142

Digitized by Google

	Page.
Neobythites (Watasea) fasciatus	142
purus	141
unimaculatus	140
Neoclinus blanchardi	460
satiricus	460
Neopelagia eximia	90
Neotheronia septemtrionalis	567
winnemanæ	567
Neoturris brevicornis	106
Netrostoma setouchianus	101
Noctoa periodita	297
Nomophila irregularis	318
Nymphites crameri	342
Obelia, species	34
Oceania blumenbachii	11
polycirrha	8
(Turritopsis) nutricula	8
Ocosteus ænigmaticus	458
Octocanna polynema	109
Ocypodidæ, new species of crabs of the family	615
Odontopyxis trispinosus	459
Odynerus (Stenodynerus) hirsutulus	445
Oenotrus bipennis	305
melanodora	305
Oligonyx scudderi	608
uhleri	608
Olindioides formosa	41, 108
Ommexecha brunneri	179
Opius (Utetes) anastrephæ	563
interstitialis	563
Orphulella intricata	178
punctata	178
Orthocryptus	567
Orthoptera, collection of, made in Peru	177
Orthoptera (exclusive of Acrididæ) collected in Peru	347
Osmilia cœlestis	187
Osmylidia requieta	342
Osmylus	341
requietus	342
Oxycercus peruvianus	350
Pacific, northwestern, medusæ and siphonophoræ collected in the	1
Palmodes rufiventris	450
Pandea conica	14, 16
massi	14
minima	14
rubra	14, 103, 105
saltatoria	14
violacea	14
Pangrapta	301
alopopis	302
herbitecta	302
Pantachogon haeckeli	44, 103, 105, 107
rubrum	44, 45, 46
scotti	44
Panurgus calcaratus	344
Paradichroplus andeanus	185
Paralebion curticaudis	225
Paraleuas minor	184
Paranatula zographica	321
Parasites, crustacean, of fish and crabs, with descriptions of new genera and species	189
Parumbrosa	94
philippina	94
Parumbrosa polylobata	94, 107, 108
Pectyllis arctica	41
Pehlkea	487
Pelagia	88
flaveola	90
panopyra	88, 108, 109
tahitaina	90
Pelmatosilpha rotundata	602
Penella exocœti	251
sultana	254
sigmoidea	254
Pentoniscus	337
pruinosus	338
Pepsis	440
Pericopis zeladon	287
Perigea pyromphalus	294
sutor	294
sutrix	294
Perilitus eleodis	561
gastrophysæ	561
Periphylla	83
hyacinthina	83, 84, 107, 108
regina	83
Pezomachus (Myrmicomorpha) perniciosa	566
Phacellophora	95
ambigua	96, 107, 110
camtschatica	95, 97
ornata	95, 96
sicula	95, 97
species?	106
Phacelodocera	487
Phascolion	373, 400
alberti	375, 401, 416
cæmentarium	373, 401, 408
spitzbergense	404
strombi	373, 375, 376, 379, 387, 401, 403, 404, 405, 408, 412
var. alba	409
canadensis	412
fusca	409
gracilis	410
hyalina	410
lævis	413
tubicola	408
tubicola	374, 404, 408
Phascolosoma	379
agassizii	424
albidum	381
approximatum	424
bernhardus	404
boreale	386
cæmentarium	391, 404
capsiforme	382
cinctum	375, 398
cinerum	375, 376, 396, 398
coriaceum	375, 398
cumanense	374, 432
cylindratum	375, 376, 382
dissors	375
elongarum	382
eremita	373, 375, 376, 382, 385, 386
var. scabra	387
flagriferum	373, 375, 376, 391
fulgens	381
fuscum	420

Digitized by Google

Page.

Phascolosoma gouldii..... 376, 378, 380, 382, 391, 394
hamulatum..... 404
improvisum..... 375, 376, 394, 395
margaritaceum..... 375, 381, 382, 388
var. meridionalis.. 375, 376, 382
minutum..... 394, 395
nigriceps..... 420
oerstedii..... 381
pellucidum..... 375, 391
perlucens..... 419
(Petalostoma) minutum.... 392, 394
procerum..... 375, 376, 383, 397, 398
riisii..... 391
sabellariæ..... 375, 376, 392, 394, 395
scutigera..... 424
variansa..... 419, 424
verrillii..... 375, 376, 388, 391, 425
vulgare..... 380, 382
Phasmidæ..... 608
Phasmomantis sumichrasti..... 608
Phialidium discoida..... 109
gregarium..... 106
pacificum..... 109
Phialucium mbengha..... 109
Phigalia cryptapheles..... 314
Philippine Islands and the Dutch East Indies, new genera and species of fishes of the families Brotulidæ and Carapidæ from the.. 135
Philippine Islands, arenaceous foraminifera from the..... 683
Philoscia muscorum..... 339
Phlyctænodes cupreicostalis..... 318
Phœtalia lævigata..... 349
Photedes mochensis..... 298
pulmona..... 298
Phycodes natalces..... 279
Phygadeuon læviventris..... 567, 567
lapponicus..... 567
(Plesignathus) epochræ..... 567
Phyllodromica abortiva..... 603
Phylloptera famula..... 356
serva..... 356
Phyllovates chlorophasa..... 608
Physcosoma..... 378, 419
agassizii..... 374
antillarum..... 374, 376, 419, 420
capitatum..... 375, 376, 419, 421
lovénii..... 422
pectinatum..... 374
varians..... 375, 376, 419
Physostegania melanorrhœa..... 310
Pimpla atrocoxalis..... 565
Plectoptera picta..... 604
poeyi..... 604
Pleonectyptera ignilinea..... 301
Pleuronichthys decurrens..... 459
Pœcilocloeus ornatus..... 184
Polistes canadensis..... 446
var. infuscatus..... 446
versicolor..... 446
Polybia belizensis..... 447
occidentalis..... 446
Polygrammodes bœuscalis..... 319
rufinalis..... 320

Page.

Polymera..... 526
albitarsis..... 528
conjuncta..... 529
georgiæ..... 537
grisea..... 636
hirticornis..... 532
inornata..... 534
lutea..... 547
niveitarsis..... 532, 537
obscura..... 528
pleuralis..... 528
superba..... 530
thoracica..... 533
Polyorchis minuta..... 106
penicillatum..... 106
Porpita pacifica..... 81, 108
Praya cymbiformis..... 65
Prionolopha serrata..... 181
Proboscydactyla flavicirrata..... 103, 106
ornata..... 109
Proctolabus bullatus..... 184
Prolabia arachidis..... 598
burgessi..... 599
Propanteles marginiventris..... 563
Prothymia cataplexis..... 301
Protiara formosa..... 14
Psalis percheroni..... 599
Psammochares (Psammochares) dichromorpha..... 441
Psaronius lituratus..... 487, 493, 495
Pseudelaphroptera (?) manura..... 447
Pseudoecanthus uniseriatus..... 203
Pseudomops cincta..... 603
intercepta..... 603
Pallocron aphrethesa..... 304
Ptilogyna..... 487
simplex..... 488
Ptychogastria polaris..... 41
Ptychogena antarctica..... 28
californica..... 28
erythrogonon..... 28
hertwigi..... 28
lactea..... 28, 30, 103, 106, 110
longigona..... 28
Ptychoglene stenodora..... 284
Ptychopteridæ, a revision of the family..... 331
Putorius lutensis..... 474
(Lutreola) lutensis..... 474
vison..... 472
vulgivagus..... 474
macrodon..... 478
melampeplus..... 477
nigrescens..... 472
vison energumenos..... 476
[Putorius vison] ingens..... 477
Putorius vison lacustris..... 475
lutreocephalus..... 473
vison..... 472
vulgivagus..... 474
Pycnocrepis..... 487
Pyramis tetragona..... 68
Pyramodon..... 175
ventralis..... 175
Pyrausta minimistricta..... 318
xanthocrypta..... 319

Digitized by Google

Page.
Radcliffe, Lewis. Descriptions of seven new genera and thirty-one new species of fishes of the families Brotulidæ and Carapidæ from the Philippine Islands and the Dutch East Indies.... 135
Ranzania makua, notes on, and other fishes of rare occurrence on the California coast... 455
Ranzania truncata.... 457
Rathbun, Mary J. Descriptions of new species of crabs of the family Ocypodidæ... 615
Rathbunella alleni.... 459
Rathkea blumenbachii.... 11, 103, 110
Reophax agglutinatus.... 637
bilocularis.... 637
Rhabdoceratites corvillese.... 611
Rhinogobius nicholsi.... 459
Rhopalonema velatum.... 44, 108, 109
Rhopilema esculenta.... 101
rhopalophora.... 101
Rhyssalus atriceps.... 559
loxotenise.... 559
oecinidis.... 559
selandriæ.... 560
similis.... 559
trilineatus.... 559
Richardson, Harriet. Terrestrial isopods collected in Costa Rica by Mr. Picado, with the description of a new genus and species. 337
Ripipteryx forceps.... 356
rivularia.... 356
Rohwer, S. A. Results of the Yale Peruvian expedition of 1911.—Hymenoptera, superfamilies Vespoidea and Sphecoidea.... 439
Rosacea plicata.... 64, 104, 107, 108
Sacandaga parva.... 508
Sagum.... 234
flagellatum.... 235
Sanderia malayensis.... 90, 108, 109
Sarsia angulata.... 3
barentsi.... 3
brachygaster.... 4
eximia.... 3, 4, 103, 106
flammea.... 3, 103
japonica.... 3, 4, 103, 106, 110
princeps.... 3, 4, 5, 103
radiata.... 3
resplendens.... 3
rosaria.... 106
tubulosa.... 3, 4, 107
Sciagraphia deceptrix.... 309
Selenia ismalida.... 311
ricochetta.... 312
Semiothisa phanerophleps.... 310
Shirakia schoenobii.... 643
Sibogita nauarchus.... 21
Sigmatomera amazonica.... 521
flavipennis.... 521
Siphonophoræ and medusæ collected by the "Albatross" in the northwestern Pacific, 1906.... 1
Siphonosoma.... 432
arcassonense.... 433
boholense.... 433
cumanense.... 374, 375, 378, 432, 433
vastum.... 433
Page.
Sipunculids of the eastern coast of North America.... 373
Sipunculus.... 378, 427
cæmentarius.... 406
(Cryptosomum) cæmentarium... 404
cumanensis.... 374, 375, 432
eremita.... 385
gouldii.... 380
norvegicus.... 430
nudus.... 374, 428, 433
phalloides.... 375, 431
(Phascolosoma) borealis.... 385
priapuloides.... 374, 375, 376, 430
var. americana.... 429
robustus.... 375, 429
titubans.... 374, 428
Sisphynx modena.... 283
Snyder, John Otterbein. Notes on Ranzania makua Jenkins and other species of fishes of rare occurrence on the California coast.... 455
Solmaris.... 56
flavescens.... 57
incisa.... 58
rhodoloma.... 57
Solmissus bleeki.... 57
faberi.... 57
incisa.... 57, 103
marshalli.... 63
Solmundella.... 63
bitentaculata.... 63, 108
South America, a revision of the dipterous insects of the family Ptychopteridæ from.. 331
Spuserocera annulicornis.... 363
Sphærophthalma peruvianus.... 450
salaverensis.... 449
Sphecoidea, hymenoptera belonging to the superfamily, obtained by the Yale Peruvian expedition.... 439
Sphex [Ammophila] volcanica.... 453
robusta.... 452
(Sphex) peruvianus.... 453
Sphyræna barracuda.... 208
Spilodes palindialis.... 319
Spirocodon saltatrix.... 109
Spongiphora brunneipennis.... 599
Stagmomantis californica.... 607
carolina.... 607
gracilipes.... 607
limbata.... 344
Staphylus holaphegges.... 281
Staurophora falklandica.... 27
laciniata.... 27
mertensii.... 27, 103, 106, 107, 110
Staurostoma arctica.... 27
Stegasmonotus.... 487
Stellerina xyosterna.... 459
Stelopolybia meridionalis.... 447
sulfureofasciata.... 447
Stenacidalia unidentifera.... 315
Stenopleura chilocida.... 645
Stephanomia bijuga.... 81
(Stephanus) Coelinius niger.... 555
Stibadocera.... 487
Stomotoca atra.... 106

Digitized by Google

	Page.
Styringomyia	487
Tachyphyle aganapia	309
Tænianthus flagellans	206
Tanyderus patagonicus	332
pictus	341
Tanypremna	487
Tarachidia leonyx	297
Tephrina submarcata	313
Tephrinopsis comaria	313
Tephroclystia glaucotincta	307
mollaria	308
Tephrosia supplanaria	315
Textularia excavata	634
immensa	633
semialata	634
vertebralis	633
Textulariidæ, new, and other arenaceous foraminifera from the Philippine Islands and contiguous waters	633
Thalpochares fractilinea	295
Thaumantias cellularia	30
species	34
Theoclytes chlorophasæ	608
Therodamas serrani	251
Thespieus cacajo	280
dalmani	280
guerreronis	280
ovinia	281
zaovinia	280
Thesprotia graminis	608
Thurammina papyracea	637
Thysanostoma thysanura	109
Thysanote longimana	257
pomacanthi	256
Tiaropsis davisii	32
diademeta	33, 103
indicans	34
maclayi	32
multicirrhata	32, 33
rosea	109
Tima	35
formosa	35
luculiana	35
saghalinensis	35, 106
Tioga bunniotis	321
Tipula armillaris	497
erythrocephala	488
filigera	488
longipes	487
maculata	488, 537
obscura	493
Tipulodina	487
Trachysphyrus cleonis	470
Triglops, two new fishes of the genus, from the Atlantic coast of North America	465
Triglops ommatistius	465
terrænovæ	467, 468
pingeli	465
Trimerotropis ochraceipennis	179
Trimicra anomala	524
pilipes	524
Tucca impressus	200
Turritopsis nutricula	8, 106
Uca arcuata	617
mearnsi	616
novæguineæ	617
triangularis	617
zamboangana	615
Urubamba	181
aptera	182, 183
inconspicua	183
Vates paraensis	608
townsendi	608
Vespoidea, hymenoptera belonging to the superfamily, obtained by the Yale Peruvian expedition	439
Viereck, H. L. Descriptions of six new genera and twelve new species of Ichneumon-flies	639
Descriptions of ten new genera and twenty-three new species of Ichneumon-flies	555
Results of the Yale Peruvian expedition of 1911. Hymenoptera - Ichneumonoidea	469
Virgulina cornuta	637
Vison lutreocephala	473
Vogtia pentacantha	66, 104, 107, 108
West Indies, crustacean parasites of fishes and land crabs, with descriptions of new genera and species from	189
Willia pacifica	109
Wilson, Charles Branch. Crustacean parasites of West Indian fishes and land crabs, with descriptions of new genera and species	189
Xenobythites	173
armiger	173
Yale Peruvian expedition of 1911, Hymenoptera, results of	439
Yale Peruvian expedition of 1911, Ichneumonoidea collected by the	469
Yale Peruvian expedition of 1911, Orthoptera (Acrididæ), results of	177
Yale Peruvian expedition of 1911, Orthoptera (exclusive of Acrididæ), results of	347
Zale rhigodora	299
Zaparaphylax perinæ	647
Zeuglodon, a skeleton of a mounted, in the United States National Museum	649
Zygodactyla coerulescens	36

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google